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THE

HOROLOGICAL JOURNAL:

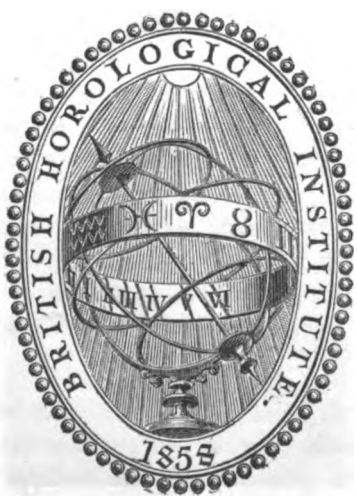
THE

Special Organ

OF THE

BRITISH HOROLOGICAL INSTITUTE.

VOLUME V.



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The Horological Journal.

VOLUME V.

SEPTEMBER 1, 1862.

TO OUR READERS.

The commencement of another Volume gives us the privilege to again address a few words to our readers in justification of our existence, as we believe that if this Journal did not serve a good and useful purpose, it would be unnecessary to request, as we hereby do, the continued assistance of our contributors.

We are certain that this Journal has honestly represented the Horological Art, as far as the artists themselves would permit; and we doubt not the use of the pen will grow even to the extent of rivalling the skill with other tools so ably wielded by our Correspondents and Readers. Our existence has promoted the proper, and so long desired, direct communication between this District and the Royal Observatory, now accomplished by Electric Wire; and to the efforts of our Members, we sincerely believe, that England is somewhat indebted for what must be admitted as the first really creditable display of English Horology at an Exhibition.

Mr. T. Gordon, who has conducted the Editorial duties during the passed three years, has found it necessary to resign his honorary office, owing to his health having suffered from too much application. The Council, and Journal Committee, fully appreciate Mr. Gordon's long and zealous labours on behalf of the Journal; and sincerely regret the loss of his services.

We firmly believe that the Institute will continue to prosper. Indeed we can have no misgivings on that point, so long as we are helped, as we have been, by such men as the Astronomer Royal and Mr. Hartnup; and to deserve such aid shall be our constant aim.

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MECHANICS.

Sixth Lecture delivered to the BRITISH HOROLOGICAL INSTITUTE.

BY W. HISLOP, ESQ., F.R.A.S., HON. SEC.

(*Continued from page* 139, *vol.* IV.)

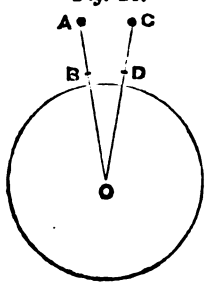
In the course of our mutual study of the Science of Mechanics we have arrived at the consideration of Gravitation and its Laws.

Gravitation is an attractive force, which forms an universal property of matter. It is the all pervading attraction of bodies throughout space, and is the unseen bond that holds together the material universe, regulating by the same laws the onward course of the heavenly bodies and the descent of the smallest particle of dust.

In taking up this subject, it is my purpose to view it in two aspects, first, as regards the earth and the matter thereon, thus including the laws of falling bodies, and secondly to trace its effects when viewed as a vast universal agent binding into one harmonious whole the myriads of mighty orbs that roll through the infinite depths of space. In its effects and relation to the earth it is called "Terrestrial Gravity," inasmuch as the earth is the great centre of attraction.

All matter, then, possesses this property of attraction; and the laws as laid down by Sir Isaac Newton, and adopted throughout the whole scientific world, are as represented in this diagram.

Fig. 24.



The gravitating forces of bodies are,

1st, Directly as their masses,

2nd, Inversely as the squares of their distances.

The earth which we inhabit is a mass of matter, nearly but not quite of a globular form, and about 8000 miles in diameter. As all the parts of a mass have gravitating power, they act in combination and may be represented as if the attraction acted only from the centre. This enormous mass then possesses the property of attracting towards its centre all bodies placed near its surface, so that if they are perfectly free to move and are opposed by no obstacle, they will proceed in straight lines towards the centre of the globe and will continue so to move until they reach the surface. If the part of the surface which they meet be solid or even specifically heavier than the descending bodies, their further approach to the centre will be obstructed, but in that case the attraction towards the centre will be manifested by the force with which the bodies press upon the resisting surface. If the bodies thus supposed to have met the surface in their approach towards the centre, happen to meet a liquid such as the sea and are specifically heavier than it, they will still continue to approach the centre, moving through the liquid until they are stopped, either by a liquid heavier than themselves or by a hard surface. All lines which are drawn from points without a globe to its centre are evidently perpendicular to its surface, and hence bodies in moving towards the centre of the earth, attracted by its influence, move perpendicularly to its surface, and when their progress is obstructed by that surface, they press on it perpendicularly with a force equal to that with which they are attracted towards the centre.

This attraction therefore is Terrestrial Gravity, and the pressure wherewith a body is forced against an interposed horizontal plane is the weight of such body.

This attraction, being an universal property of matter, is generally supposed to differ from magnetism, and other attractions which are resident only in substances of particular species. If the earth were a large magnet possessing only magnetic attraction, those peculiar substances only which are affected by the loadstone would have weight or would fall to the surface when unsupported. All other bodies would rest indifferently in any position in which they might happen to be placed and would move upwards just as readily as downwards. It is however by no means certain that there is not some connection between the attraction of magnetism and the attraction of gravitation. We know that magnetism exists in the earth from the directive tendency evinced by the freely suspended magnetic bar or needle, and we are becoming gradually informed of the fact that all or most substances are susceptible of attraction by magnetism. Why then may not the earth be an immense reservoir of electricity or magnetism in such gigantic proportions, as to draw all minor bodies towards it with a perceptible attraction. Dr. Laming in a communication brought before the British Asssociation, I think in 1846, and which is recorded in No. 1525 of the Literary Gazette, propounds a new theory of matter, and in the course of his speculations, he asserts that, "Electricity is the only body that possesses weight." "Everything owes its weight to Electricity." This he states he has experimentally proved by communicating to a cylinder nicely balanced and protected from foreign influence, different quantities of electricity. This cylinder with a plus charge descends or has a tendency to descend, with a minus charge it

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ascends. The truth of this experiment Dr. Laming said was admitted by the Academy of Sciences at Paris, seven years before, but no report upon the subject was ever made.

Every material substance is susceptible of the attraction of gravity in the exact proportion of its mass. Thus if the mass of the earth were doubled it would exert a double attraction on all bodies in relation to it, and consequently the weights of all such bodies would be doubled. If its mass were tripled the weights of all bodies would be tripled, and so on.

As the earth attracts all terrestrial objects towards itself, so it is attracted towards them in return, in fact as a falling body is attracted with a certain force towards the earth, the earth itself is attracted towards it by the same force and instead of the falling body alone moving, which is the phenomenon observed, the earth and it move towards each other and meet at some intermediate point. Since all the bodies around us participate in this motion it would not be directly observable even though its quantity were sufficiently great to be perceived under other circumstances. But setting aside this consideration, the space through which the earth moves in such a case is too minute to be the subject of sensible observation, and for this reason, that the space through which the larger body approaches the smaller, bears to that through which the lesser approaches the greater, the same proportion as the mass of the lesser bears to the mass of the greater. Now the mass of the earth is more than 1000 millions of millions times the mass of any body which is observed to fall on its surface, and therefore if even the largest body which can come under observation were to fall through a height of 500 feet, the corresponding motion of the earth would be through a space less than the thousand million millionth part of 500 feet, which is less than the hundred-thousand-millionth part of an inch. It is therefore quite evident that with regard to falling bodies the earth is to be considered at rest.

Bouguer and De La Contamine have however discovered and proved that high mountains exert a perceptible influence, by attracting falling bodies or suspended bodies towards themselves. They found that Chimborazo in South America afforded sufficient local attraction to furnish data for future enquiry. Maskelyne in 1772 suggested the employment of observations in the neighbourhood of a mountain for the determination of the earth's mean density. This was effected at Schehallien in Scotland by observing the amount of deviation in a plumb line suspended near it from a line actually pointing towards the centre of the earth.

A series of experiments has been recently undertaken and completed by Professor Airey, for the purpose of determining this and other points, and the verified results have been made known in some elaborate papers on the subject. .In this instance pendulums were used, one set being placed at the top and the other at the bottom of a deep mine; their vibrations were noted and compared by the aid of electro magnetic apparatus, a connection being made between the top and the bottom by an electric wire. I shall speak more at length of these experiments when we arrive at the consideration of the pendulum.

The attraction between the earth and detached bodies on its surface is not only exhibited by the descent of these bodies when unsupported but by their pressure when supported, this pressure, as I have already stated, is called weight. The amount of a body's weight is proportional to its mass; hence the earth attracts different bodies with different forces. A piece of lead contains a considerably greater quantity of matter in the same bulk than a piece of cork, and accordingly we find that the earth attracts it with a proportionably greater force. In other words it has more weight. Particle for particle, however, all matter weighs the same. A pound of feathers is as heavy as a pound of lead, but the pound of feathers if allowed to fall will take a longer time for its descent, than the pound of lead. This arises from the matter being more diffused in the former case and thereby resisting its descent through the atmosphere in a greater degree. If the bodies were caused to descend in a vacuum, they would both fall with the same speed. This is proved by what is called the guinea and feather experiment, in which a tall glass receiver is exhausted of air, and a coin and feather being arranged at the top so as to be simultaneously discharged by a trigger, will fall through the vacuum with the same relative speed and strike the base together.

Weight is generally assumed as the measure or exponent of the quantity of matter in any substance, whatever in other respects be the species or qualities of that substance. Thus the relative weight of equal volumes expresses the density of matter; the more any body weighs with equal volumes, the denser it is. This density of bodies is usually expressed in numbers, that of pure water being assumed as unity; and the particular weight of each body is its specific gravity.

I have already alluded to the fact that falling bodies descend towards the centre of the earth. Every cord to which a body is freely suspended assumes this line of direction when in a state of rest, and thus becomes a semi-diameter of the earth produced. Such a cord is called a plumb line, the line which it marks out is a perpendicular, and a line or plane at right angles to it is said to be horizontal. As these plumb lines point towards a common centre, it might be expected that any two of them would appear not to be parallel to each other. Thus if A B and C D (*fig.* 24) be two plumb lines, each will be directed to the centre O, where, if their directions continued they would meet. Observation on the contrary would go to prove that plumb lines suspended in places not far distant from each other, are truly parallel, and that bodies allowed to fall descend in parallel lines. This apparent parallelism of the direction of terrestrial gravity is accounted for by the enormous proportion which the magnitude of the earth bears to the distance between the two plumb lines or the two falling bodies which are compared. If the distance between the places B D was 1200 feet, the inclination of the lines A B and C D would not amount to a quarter of a minute or the 240th part of a degree. The convergence in one geog. mile is one min. and in 60 geog. miles it is one degree. The distance of lines therefore the parallellism of which is assumed,

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being usually but a few yards, the inclination of the line of direction is too small to be appreciated by any practical means.

In the investigation of the laws of falling bodies, therefore, we may assume that all the particles of a body are attracted in parallel directions perpendicular to an horizontal plane.

The distance of a body from the earth will have a certain effect in modifying the force of gravity. Until Newton said that what we call weight of bodies is merely an instance of the universal attraction of matter which diminishes with increasing distance, it was never suspected that weight was less high up in the air than on the ground, or on a lofty mountain than on the sea-shore. But it is now known that gravitation decreases inversely as the square of the distance from the gravitating centre. Thus, a body placed upon the surface of the earth, at a distance of 4000 miles from its centre, is attracted by a certain force; at double that distance, or 4000 miles from the *surface*, it would only be attracted by a fourth part of that force, and in fact lose three-fourths of its weight.

For this reason, the force of gravity at different parts of the earth's surface has different intensities, owing to the flattened spheroidal form of the earth, the surface at the equator being further from the centre than the surface at the poles; gravitation, therefore, diminishing with the latitude. The actual amount of this variation in any distances or masses which may come under our notice is so small as to be inappreciable. For instance, if a body descended through half a mile, the distances from the centre at the beginning and end of the fall are in the proportion of 8000 to 8001, and therefore the proportion of the force of attraction at the commencement to the force of attraction at the end being that of the squares of their numbers, or 64,000,000 to 64,016,000 in the whole descent, amounts to an increase of one part in 4000, a quantity practically insignificant.

As gravity is a constantly acting force, the resulting motion must be an uniformly accelerating motion. Owing to the inertia of matter, any force continuing to act in a mass which is free to obey it, produces in the mass a quickening or accelerating motion, for as the motion given in the first instant continues afterwards without any further force, merely on account of the inertia, it follows that as much more motion is added during the second instant, and as much again during the third, and so on. A falling body, therefore, under the influence of attraction is, as it were, a reservoir receiving every instant fresh velocity and momentum.

It is said that Newton's sublime genius read the nature of attraction in the simple incident of an apple falling before him from a lofty branch in his garden. The eye can follow the fall of an apple for a time, and mark the gradual acceleration of its descent, but soon sees its path only as a shadowy line. If we let a ball fall from the hand we can catch it again the first instant, but after a little delay the hand follows it in vain. A fragment of rock detached from the brow of a mountain by the lightning stroke begins its motion slowly, but once fairly launched, it gathers fresh speed and momentum with every instant, and bounds from steep to steep driving every obstacle before it. Any liquid falling from a reservoir forms a descending mass or stream of which the bulk diminishes from above downwards, in the same proportion in which the velocity of the particles increases.

This truth is well exemplified in the pouring out of a thick fluid; if the height of the fall be considerable, the bulky sluggish mass which first escapes is reduced before it reaches the bottom to a small thread, but the thread is moving proportionably faster, and fills the receiving vessel with singular rapidity.

The same truth is exhibited on a vast scale in the Falls of Niagara, where the broad river is first seen bending over the precipice, a deep slow-moving mass, then becoming a thinner and thinner sheet as it descends, until at last, surrounded by mist, it flashes into the deep with tremendous velocity.

When velocity becomes considerable in any case of falling, it cannot be measured accurately by the eye, but its effects ascertain it. A man leaps from a chair with impunity, from a table with a shock, from a high window with fracture of his bones, and in falling from a balloon his body is literally dashed to pieces.

We thus see that the velocity of a falling body is proportional to the time occupied in its descent, and that it is also necessary to take into consideration another element, namely the space fallen through in given intervals of time. As a true calculation of the velocity which a falling body acquires in any given time depends on the space fallen through in that time (say one second) it is absolutely necessary to know the amount of such space. This has been found, in England, to be $16\frac{1}{12}$ feet. Now if a falling body descend through a certain space in the first second of its fall, it will descend through four times that space in the first two seconds, nine times that space in the first three seconds, sixteen times that space in the first four seconds, and, in fact, in order to find the space through which a body will fall in any given number of seconds, multiply the space through which it falls in one second by the square of the number of seconds in the whole time of its fall.

Knowing then the progress of a falling body, its velocity and the distance through which it falls may easily be ascertained: and the height of a precipice or the depth of a well may be judged of with considerable accuracy by marking the time required for a body to pass through the space.

We deduce from these facts the following laws:

1st, The final velocity, or velocity at the end of the time of descent increases as the time, or as the numbers 1, 2, 3, 4.

2nd, The spaces fallen through in equal portions of time increase as the odd numbers, 1, 3. 5, 7.

3rd, The whole space fallen through increases as the squares of the times, or as 1, 4, 9, 16.

4th, If a body continue in motion after the force of gravity is suspended, it will descend in an equal time twice the distance of the first descent.

To submit these several laws which thus govern the descent of heavy bodies to direct experiment

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would be attended with considerable difficulties, A body will fall in a single second through the height of about 16 perpendicular feet; in two seconds it will fall through 64 feet; and in four seconds through 256 feet. Thus, if our experiments were limited to four seconds of time, it would be necessary that we should command a height of 256 feet. But further, in observing the velocity considerable difficulty would arise from its magnitude. The velocity acquired in one second would be 32 feet, and therefore the velocity acquired in four seconds would be 128 feet per second, or 1780 feet per minute. Independently of these difficulties, the resistance which the atmosphere would offer to such rapid motions would be so considerable as to produce a great discordance between the effects observed and the laws which have been laid down on the supposition that all resistances to the free descent of the body are removed.

Nevertheless the truth of these laws can be established by the most rigorous experiments, and although the impediments to which I have alluded cannot be directly removed they may be evaded. It occurred to Mr. George Atwood, a mathematician and natural philosopher of the last century, that the phenomena of falling bodies might be experimentally exhibited and accurately observed if the force of gravity could be so modified, by its quantity being diminished, as to admit of convenient measurement. He conceived that thus the particulars of time, space, and velocity would be unaltered in their properties, while the resistance of the air would produce no sensible effect.

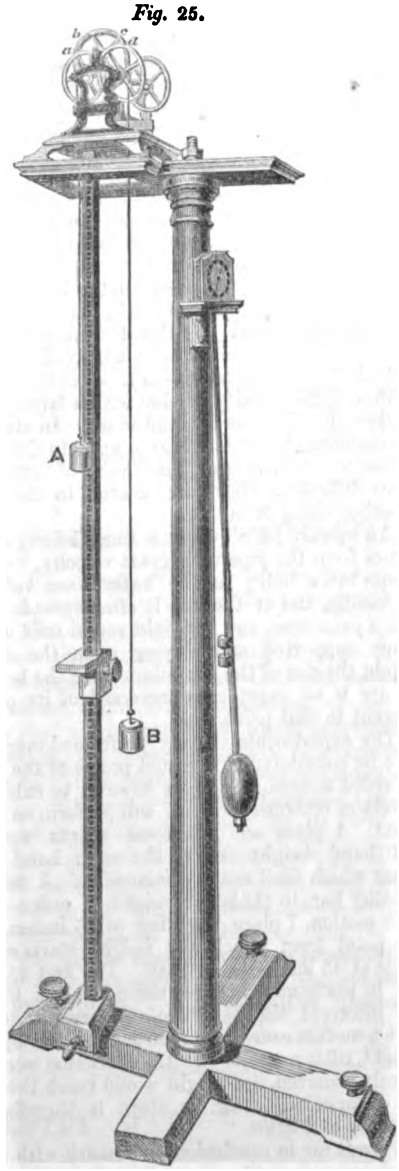
To realize this idea, Atwood constructed a machine consisting of a wheel turning on its axis with very little friction, and having a groove on its edge to receive a string. Over this wheel, and in the groove, he placed a fine silken cord to the ends of which he attached equal weights. In this condition the system was necessarily in equilibrium. To one of the weights he then added a small quantity, so as to give it a slight preponderance. It consequently began to descend, drawing up on the other side the unloaded weight. Setting aside the friction of the wheel, the descent of the loaded weight is a motion of exactly the same kind as the descent of a heavy body falling freely by the force of gravity, that is it is a uniformly accelerating rate, with this advantage, that the acceleration may be rendered as slow as convenient by diminishing to any degree the preponderance given to the heavier weight.

This modified motion arises from the fact that not only is the inertia of the added weight to be overcome by the force of gravity, but as it cannot move without the whole system, the same force has to overcome a large amount of inertia, such inertia being constant. Thus, if weights of three ounces each be made to balance each other by a cord passing over a pulley, and be then put in motion by a weight of one ounce hooked to one of them, it is evident that inertia has to overcome not the weight of one ounce only, but of seven, for the other two weights must move as fast as the one ounce does, and thus the velocity being reduced to the one-seventh of that natural to a falling body, the descent can be minutely observed.

If it be required that the descending weight should fall only one inch in the first second instead of $16\frac{1}{10}$ feet, or nearly 193 inches, then the additional weight to be placed on the system must be $\frac{1}{193}$ of the entire mass that is to be set in motion.

The original form of this machine is shown in this engraving (*fig.* 25.) The axle of the pulley

Fig. 25.



rests on wheels which are free to revolve, thus altering rubbing to rolling friction, in order that motion may be as free as possible. A time-piece with a second's pendulum is affixed to the pillar, for the purpose of marking the time occupied in the descent of a body. In the machine which I am now about to use I have suspended the pulley on small steel centres, which I find a sufficiently fine arrangement for general purposes. I have

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also a heavy pendulum and a contrivance which causes the pendulum itself to release the weights at the commencement of a beat, thus securing their coincidence.

[A series of experiments was then performed, by the aid of the instrument, demonstrative of the various positions advanced, but these experiments would be of little value if described without being actually performed and seen.]

The same things are true in a reversed way of a rising body subjected to the same influence. A bullet shot directly upwards every instant loses a part of its velocity, until at last it seems to rest in the sky, where the eagle might behold the messenger of death motionless and harmless for a moment by his side. The ball then descends again, so that at corresponding points of the ascent and descent, but for the resistance of the air, the velocities would be equal, and on reaching the ground would have acquired exactly the velocity with which it first departed.

I have already explained that a body falls four times as far in two seconds as in one, although the velocity at the end of the two seconds is only double. For the same reason a body shot upwards with double velocity rises four times as far as if shot with a single velocity, if shot with a triple velocity it rises nine times as far, and so on. In aiming for amusement at bodies thrown up into the air it is easier to hit them near their point of turning, and more difficult as they are nearer to the ground whether rising or falling.

An upward jet of water is small below, where it issues from the pipe with great velocity, but it becomes more bulky as the water loses velocity in ascending, and at the top it often spreads a little, like a palm tree, and any light round solid will continue supported and playing upon the summit. Again the rise of the pendulum from the bottom of its arc is an exact copy reversed of its previous descent to that point.

The experiments already performed may therefore be considered as inverted proofs of the laws of retarded motion. In order however to exhibit the effects of retarded motion I will perform an experiment. I place an additional weight upon the left hand weight and on the right hand weight a bar which shall exactly balance it. I now add another bar to the latter weight in order to put it in motion. I place the ring at 45 inches below the point from which the weight starts and the stage at 45 inches below that. The first 45 inches will be performed in three seconds, when the ring will intercept the bars while the weight goes on with a motion constantly retarded by the opposite weight, till it comes to a rest. If friction were completely removed, the weight would reach the stage, the distance at which it stops is therefore the measure of friction.

Permit me in conclusion to remark with regard to these and similar experiments which I have brought before you in these lectures, that they must be regarded simply as illustrative. Philosophers claim no higher place for them, but in the first instance as a preliminary, endeavouring to satisfy the condition either of equilibrium or of moving force; should results be obtained similar in character to those which are known to obtain in those bodies which are too vast for us to experiment with, we are warranted in adducing such experiments as illustrations of natural phenomena.

No true philosopher would generalize upon an experiment essentially artificial in its character. Generalization in Astronomy, Mechanics, and the related Sciences, must be grounded upon natural phenomena themselves, and theories, to have any real weight, must be based upon what is known actually to happen in the universe.

AUXILIARY COMPENSATION.

To the Editor of the HOROLOGICAL JOURNAL.

Sir,—I beg to hand you a description and a photographic sketch of a chronometer balance, which I fell across lately, possessing considerable merit, especially as having a breadth of adjustment of its auxiliary part for extremes both of heat and cold beyond that shown by many forms in general use.

Although from some cause or other this balance has been seldom applied, I think you will perceive the effective nature of the auxiliary part. The ease with which the parts may be made, or even applied to balances in actual use, should have made it popular.

It consists, as shown, of an ordinary balance with an auxiliary worked by inclined planes as follows.

Fig. 1.

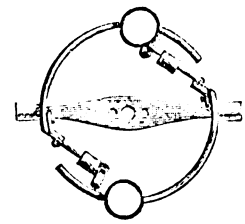
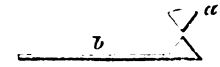


Fig. 2.



A piece of brass or steel is attached to the rim of the balance about one-fourth of its length from the loose end—carrying an upright piece of ruby, shaped as *a* (*fig.* 2) presenting the round side towards the centre of the balance.

On small cocks screwed to the ends of the arm of the balance small stems of tempered steel are attached by screws, and reaching the pieces of ruby before-mentioned at which point they are filed into two inclined planes (*b fig.* 2) and by their own elasticity keep these shaped points constantly in contact with the ruby surfaces before-mentioned, carried by the rims.

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Now as the flexure of the laminæ of a balance is not radial, but any given point in the rim describes a curve by alteration of temperature, the inclined planes will necessarily be presented to each other in different positions, and motion either to the right or to the left, otherwise high or low temperature, will permit the auxiliary weights to approach nearer the centre. These weights are slipped on the stems and are clamped by screws at any point of the stem, where by experiment they are found to effect the amount of work required of them, they being more or less active as they are moved towards the ends of the stems or *vice versâ*.

It will further be seen that by leaving a small flat surface at the junction of the two inclined planes on the side of the stems, the auxilary action may be made to commence at any given point of the thermometric scale, and above all, the action need not commence suddenly as is the case with the majority of the auxiliaries employed. If you think it worth saving from oblivion, the insertion of this letter will oblige. Your's most obediently, GNOMON.

RATING CHRONOMETERS ON TRIAL AT GREENWICH.

To the Editor of the HOROLOGICAL JOURNAL.

Sir,—I should be much interested if some of your scientific correspondents would give the *rationale* of the rule by which the order of arrangement of the chronometers in the published Greenwich rates is determined. I have little doubt there are other readers of your valuable Journal who would feel an equal interest with myself in the explanation. It is stated (as for instance, in the rates given in Vol. III., p. 24, of this Journal) that "the order of arrangement of the Chronometers in these Tables is determined solely by consideration of their irregularities of rate, as expressed in the columns 'Difference between the Greatest and Least' and 'Greatest Difference between one week and the next,'" but it is not stated what use is made of these two columns. However, in Mr. Loseby's controversy about *Secondary Compensation*, in the Journal of the Society of Arts for 1853, the rule is given by Mr. Loseby in the following words.—

"Having noticed Mr. Denison's rule, I will now describe the method by which the merits of the chronometers have been determined at the Observatory for many years past. This method consists in ascertaining from the weekly sums of daily rates in the order of time (not in the order of temperature, as Mr. Denison has it), first, the difference between the greatest and least weekly rate during the whole trial; and secondly, the greatest difference between one week and the next. These errors are given in two columns on the last page of the rates; and the chronometers are arranged in the order of merit by multiplying the number of seconds in the column headed 'greatest difference between one week and the next' by two, and adding the product to the seconds contained in the other column, which gives the trial number."

On applying this rule to the rates before alluded to at p. 24, vol. iii., of this Journal, the trial numbers of the first six chronometers will be found to be respectively 25·3, 25·8, 27·3, 28·7, 29·6, 30·6. This rule therefore appears to be still adhered to, but I cannot exactly see upon what principle it determines the merit, and would be much obliged to any correspondent who would state the rationale. I remain, Sir, your's very obediently, G. H.

Edgbaston, Birmingham.

LONGITUDE OF NEUFCHATEL.

The following communication has been received from our esteemed correspondent Mr. C. GUILLAUME:—

"Two chronometers brought over from the Neufchatel Observatory in April last, by the maker, Mr. H. Grandjean, of Locle, were rated again at the Royal Observatory, Greenwich, on their arrival in this country, and from those double observations it results that the difference of time between Greenwich and Neufchatel is 27m. 49·2s.

"The indications of each chronometer differed only by 0·4s.; No. 85 indicating a difference of 27m. 49·00s.; and No. 86 a difference of 27m. 49·41s.

"Two years ago a result corresponding exactly with the mean of these observations (viz. 27m. 49·2s.) was obtained through Geneva."

COVENTRY WATCHMAKERS' ASSOCIATION.

There exists at Coventry an association, acting under the above title, whose objects appear so laudable, and so self-helpful, that we cannot do better than give all the publicity possible to their efforts.

For this purpose we give our readers a copy of a hand-bill, recently issued by their committee and hope this effort will be so

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successful as to stimulate the extension of the principle, seeing that the result must be beneficial.—ED. B. H. J.

COVENTRY WATCHMAKERS' ASSOCIATION.

The Committee of the Coventry Watchmakers' Association submit the following Prizes for Public Competition, in the earnest hope that, although small in amount, they may evoke a spirit of emulation in the improvement of our art, and aid in developing some of the latent talent of our artizans:—

First prize of £2, for the best improvement in the construction of the Watch Movement.

Second prize of £1, for the invention of a New Tool; or best improvement of a Tool, at present in general use in the Watch Trade.

Four prizes of 10s. each, for the invention of New Tools; or improvement of Tools now in general use in the Watch Trade.

Conditions of Competition.

Simplicity of construction, to promote economy in production, an essential feature in competing for the first prize.

Their complete adaptability in facilitating the labour of the workman, an indispensable qualification in the specimens offered in the competition for the prizes for tools.

All specimens intended for competition must be sent CARRIAGE PAID to the Secretary, Mr. WILLIAM MAY, 39, Hill-street, Coventry, not later than the 7th of September, properly marked, accompanied by a corresponding mark in a sealed envelope, to be opened when the Judges have made their award.

Three qualified persons will be selected by the committee to act as Judges, who will make their award, and the prizes will be distributed at the Annual Meeting of the Association, to be held in St. Mary's Hall, Coventry, on Monday Evening, October 6th 1862.

A certificate of merit will be given with each prize, but the Judges will be empowered to withhold any prize should they consider the article exhibited of insufficient merit to deserve it.

ABRIDGMENTS OF

SPECIFICATIONS OF PATENTS

RELATING TO WATCHES, CLOCKS, AND OTHER TIMEKEEPERS.

(*Continued from page* 145, vol iv.)

1847, July 3,—No 11,776.

WEARE, ROBERT.—The invention relates to the application of magnetism and electricity to the vibrations of balances and pendulums, and consists:—1. In giving motion to the balance or pendulum by means of two semicircular permanent steel magnets, with their positive and negative poles facing each other respectively; these magnets vibrate freely on their own axis through a brass barrel, in which is contained a coil of copper wire covered with cotton. The wire is wound round a wooden reel with its centre hole sufficiently large to allow the magnetic balance to pass freely into it. The patentee describes several batteries to produce the electric fluid, and an apparatus which is to be placed between the magnetic coil and the battery in order to reverse the polarity of this coil, by which alternate reversion the continual and perpetual motion of the balance is kept up.

2. Giving motion to a balance by means of a magnetic needle passing through a coil of copper wire of an oval form such as that used in a common galvanometer.

3. Giving motion to a balance by having an electro bar magnet fixed to the balance staff. Placed in contact with the poles of this is a permanent magnet of a long shape, curved at both ends, so that the ends of the permanent magnet come opposite and close to the ends of the electro-magnet.

4. Giving motion to a balance by electricity alone by means of "what is called a dry pile." The one the patentee uses is made of plumbago, zinc, and paper.

5. The application of electricity alone to the vibrations of a pendulum.

6. Giving motion to the balance by means of horseshoe magnets acting with the poles of a magnetic needle, causing attraction and repulsion every alternate vibration of the balance, by means of a lever worked by a small collet on the bottom of the balance staff.

7. The application of horseshoe magnets to the vibrations of a pendulum having a magnetic needle or bar applied to it.

[Printed, 1*s.* 8*d.* See Repertory of Arts, vol. 11 (*enlarged series*), p. 129; and Patent Journal, vol. 4, p. 175.]

1847, December 1.—No 11,985.

MOENCK, GUSTAVUS.—A detached escapement, dependent on the law of gravity, and totally independent of the wheelwork. On the axis of the escape wheel is a lever, of any desirable shape, which has an

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upper arm inclined at an angle, and which arm carries an adjustable weight. The lower arm of the lever is furnished with a pin, so as to permit it being taken hold of by a catch and spring. The motion of the pendulum one way releases it from this pin, and the weight causes the lower arm of the lever to advance, thereby giving a fresh impulse to the pendulum; it then strikes a spring and releases the escape wheel, which wheel carries the lower arm back again to its position behind the pin, ready to be again released by the motion of the pendulum.

[Printed, 5*d*. See Repertory of Arts, vol. 11 (*enlarged series*), p. 159; London Journal (*Newton's*) vol. 32 (*conjoined series*), p. 182; and Patent Journal, vol. 5, p. 148.

1847, December 7.—No. 11,987.

EIFFE, JAMES SWEETMAN.—1. Relates to balances, and consists in the application of arms out of the radial line at any angle of inclination, to the rim of compensating power, or to a balance rim constructed of one substance only. These arms may be made of any shape and direction, curvilinear or otherwise.

2. Relates to the pendulum of astronomical clocks, and other timekeepers, and consists in the use of a receptacle of conical or varying form instead of the one of perfectly cylindrical form used in the pendulum known as "Graham's Mercurial Pendulum."

3. On the ends of two levers, the opposite ends of which are hammers, are pieces of steel which come in contact with two levers placed on the "anchor angles" of the pallets. During the outward motion of the anchor angles, these two levers are made to pass the pieces of steel without disturbing the hammers; but on the contrary motion, the hammers strike, and thus loud beats are produced simultaneously with the slight beat of the escape wheel teeth. The levers may also be attached to the axis of the pallets instead of to the pallets.

4. A remontoir spring. "The remontoir keeps the bearing of the driven leaf always with the action side in contact. The motion from the barrel always keeps the spring wound up." A circular plate has three studs against which a brass disc is forced by the spring. "By the free motion of the disc on the axis and the resisting power of the three pins on the main plate, the remotiop" is produced.

5. The steel spring of the pendulum passes through a bracket, and the upper part is attached to a compensating adjustable lever.

6. "Burnishing the periphery of balances by a cylindrical weight affixed and supported to its burnishing pressure by a strong wooden frame, numerically applied to ensure uniformity and truth, when the balance may be intersected for its compensating use."

[Printed, 10*d*. See London Journal (*Newton's*), vol. 34 (*conjoined series*), p. 239; and Patent Journal, vol 4, p. 498.]

1848, May 11.—No 12,154.

RESTELL, THOMAS, and CLARK, RICHARD.—1. Relates to escapements. The peculiarities consist in dispensing with the detent spring, lifting spring, compensating balance, and occasionally the balance or pendulum spring. The curve of the locking detent is also peculiar; consisting of a compound curve, one half of which is concentric with the periphery of the escape wheel, and the other half is obtained by shifting the centre of the curve a little on one side of the centre of the escape wheel.

2. Relates to the compensation of balance springs. The outer end of the spring is connected to the curved arm of a T-shaped lever, the opposite end of which has a graduated curved arm; a brass or metal arm or a tube of mercury presses against this graduated curved arm, and, as the balance spring elongates, itself will elongate and force the arm back, thereby shortening the balance spring.

3. Adapting musical boxes to clocks, so that the musical box plays immediately before the hour is struck. On the axle of a wheel in the clock which makes one revolution in an hour, is an arm, which, just before the termination of every hour, acts on certain levers, one of which prevents the musical barrel from working until it is removed by being so acted upon.

[Printed, 1*s*. 1*d*. See London Journal (*Newton's*) vol. 34 (*conjoined series*), p. 232; Mechanics Magazine, vol. 49, p. 502; Artizan, vol 7, p. 105; and Patent Journal, vol. 6, p. 84.]

1849, March 14.—No 12,516.

PAYNE, WILLIAM.—The patentee claims an improvement in clocks which indicate the hours, half hours and quarters by means of musical intonations or chimes. Instead of having bells struck by hammers with the usual machinery, the patentee uses a barrel studded with pins so arranged and calculated as to produce the musical chimes by acting upon elastic metal springs fixed securely in the framework of the clock.

[Printed, 5*d*. See Mechanics' Magazine, vol. 51, pp. 282 and 361; and Patent Journal, vol. 7, p. 250.]

1849, March 14.—No 12,522.

CHAUFFOURIER, PIERRE AUGUSTIN (*a communication*).—Dividing the depth of the watch into two horizontal compartments. The main spring is set at the exterior plate so as to occupy the entire space of one of these compartments; the other parts of the mechanism occupy the entire space of the other. These latter are the ordinary works but have to be arranged so as to agree with the displacement of the moving power.

[Printed 6*d*. See Mechanics' Magazine, vol. 51, p. 283.]

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METEOROLOGICAL OBSERVATIONS, Taken at 9 A.M., JULY 1862.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	29·927	60	57	64	52	N	3	o	o, r
2	29·821	60·5	57	67	57	W	5	o	or
3	29·919	56·5	50·5	66	50·5	W	3	o	r, cb
4	29·917	55	51·7	57·5	47·5	SW	3	cb	cb
5	29·703	59·5	57	63	54·5	S	3	om	rr, o
6	29·478	61·5	57	67	52	SE	6	c	cb
7	29·654	60	54·5	68	56	WSW	7	cb	r, b
8	30·019	60	57	64	55	W	3	cb	bc
9	30·070	60·5	57	70	56	SW	6	o	r, o, r
10	29·783	59	56	64	55	W	5	c	o, r, bc
11	29·941	54	50·5	64	47	NW	3	o	o, rr
12	29·496	58·5	58	61	52	W	2	c	o, r, cb
13	29·867	59·5	56·5	66	52	W	4	bm	bc
14	29·897	64	61·5	69·5	59	SW	3	cb	bc
15	29·832	60	55	71	53·5	W	3	bc	bcr
16	29·773	58·5	54·5	66	51·5	W	4	bc	c,tlhr, c
17	29·913	57	52·5	65	49	W	4	cb	cr
18	29·938	60·5	55	66	56·5	NW	4	bc	cb
19	30·047	62	56	68	56	SW	5	c	cb
20	30·123	59·5	53	66	52	NW	6	b	bc
21	30·194	59·5	54	67	54	NW	5	cb	bc
22	30·250	58·7	53	68	52	W	2	bc	bc, or
23	29·967	57·5	56	66	54	NE	1	rm	ro, ocm
24	30·047	60	57	61	55	SW	3	r	c, bcq
25	30·044	63·5	58	68	58	WNW	4	bc	bc
26	30·116	65	58·5	72	56	SW	2	bc	b
27	30·088	62	57·5	78	57	SSW	2	bc	b
28	30·176	59	54·7	71	52	NNW	2	b	bcm
29	30·104	60·5	57	69	54·5	NE	1	b	bc, r
30	30·097	60	57	72	55	N	2	cb	cbr
31	30·128	62	58	69	55	SW	4	cb	b
	29·946	59·8	55·7	6 7	53·8		3·6	Mean.	

REMARKS.

This being the commencement of the Fifth Volume of the Horological Journal, it is desirable to state once for all, that, in these Tables, the general condition of the weather is recorded by letters, which signify as follows:—b, blue sky; c, clouds (detached), or cloudy; f, fog; h, hail; l, lightning; m, mist or haze; o, overcast; p, passing showers; q, squally; r, rain; s, snow; t, thunder; and a letter repeated denotes *much*, as ff, thick fog; rr, heavy rain;—that the force of the wind is estimated by the "sea scale," 0 to 12,—0 being calm and 12 the strongest hurricane:—that the barometer observations are all reduced to 32° Fah., at the mean sea-level:—and that the rain-gauge is on the ground, about 55 feet above the sea-level.

The barometer maximum was 30·276 at 11 p.m. 21st, the minimum 29·462, at 3 p.m. 12th; shewing the monthly range to have been, at least, ·814 inch.

On the 24th a gale commenced suddenly about 6 p.m. and lasted through the night, the wind veering from S to WNW.

Rain fell on 17 days, during about 68 hours, to the amount of 2·27 inches.

According to the 9 a.m. observations, the wind blew from the N on 6 days; E, 2; S, 6; and W, 17 days.

EQUATION OF TIME TABLE

FOR SEPTEMBER, 1862.

Day of the Week.	Day of Month	At Apparent Noon. Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At Mean Noon. Equation of Time to be *added* to Mean Time
		m. s.	s.	m. s.
Mon..	1	0 5·29	0·787	0 5·29
Tues..	2	0 24·17	0·799	0 24·18
Wed..	3	0 43·36	0·811	0 43·37
Thurs.	4	1 2·83	0·822	1 2·84
Frid..	5	1 22·55	0·832	1 22·57
Sat...	6	1 42·51	0·841	1 42·54
Sun...	7	2 2·69	0·849	2 2·72
Mon..	8	2 23·06	0·857	2 23·09
Tues..	9	2 43·61	0·863	2 43·65
Wed..	10	3 4·31	0·868	3 4·36
Thurs.	11	3 25·13	0·872	3 25·19
Fri...	12	3 46·06	0·875	3 46·12
Sat....	13	4 7·08	0·878	4 7·14
Sun...	14	4 28·16	0·880	4 28·22
Mon..	15	4 49·28	0·880	4 49·35
Tues..	16	5 10·41	0·880	5 10·49
Wed..	17	5 31·55	0·880	5 31·63
Thurs.	18	5 52·66	0·878	5 52·74
Fri...	19	6 13·72	0·875	6 13·81
Sat....	20	6 34·73	0·872	6 34·83
Sun...	21	6 55·68	0·869	6 55·78
Mon..	22	7 16·53	0·864	7 16·62
Tues..	23	7 37·26	0·858	7 37·36
Wed..	24	7 57·86	0·852	7 57·97
Thurs.	25	8 18·32	0·846	8 18·44
Fri...	26	8 38·63	0·838	8 38·75
Sat...	27	8 58·75	0·830	8 58·88
Sun...	28	9 18·68	0·821	9 18·82
Mon..	29	9 38·39	0·812	9 38·52
Tues..	30	9 57·87	0·802	9 58·01

TO CORRESPONDENTS, &c.

All Communications for this Journal should be addressed to the EDITOR, *at the Office*, 35, Northampton Square, Clerkenwell.

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MECHANICS.

Eighth Lecture delivered to the British Horological Institute.

By W. Hislop, Esq., F.R.A.S., Hon. Sec.

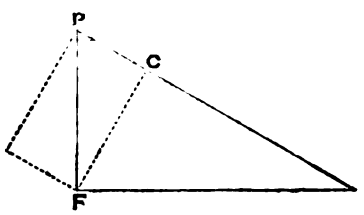
(*Continued from page* 8.)

On Gravitation, Motion of Projectiles, the Motion down Inclined Planes and Curves, the Theory of the Pendulum, and the Effect of Gravitation on the Heavenly Bodies.

There are certain instances of motion in which the force of gravitation acts a very important part, sometimes in causing, at other times in modifying such motion. A body placed upon a plane inclined to the horizon glides or rolls down to the lower extremity of that plane. This is caused by the attraction of the earth, and like the descent of a falling body is likewise an uniformly accelerated motion. A body placed upon a hard unyielding surface, will remain at rest if the force or resultant of the force is directed perpendicularly against the surface; in this case the effect produced is pressure, and we shall have to consider it in this relation, when we treat the subject of the Mechanical Powers. If however the line of the direction of the forces be oblique to the surface, the effect will be equivalent to that of two forces, one in the direction of the surface and the other perpendicular to it. The *latter* will be resisted, and will produce a pressure, while the former will cause the body to *move*. The effect of the force is therefore distributed between motion and pressure in a proportion which depends on the obliquity of its direction to that of the surface.

The extreme cases are: 1st, When it is in the direction of the surface, it then produces motion without pressure; and 2nd, When it is perpendicular to the surface, it then produces pressure without motion. In all intermediate directions it will produce both these effects. Now if we suppose P F (*Fig.* 26) to represent the force of gravity, and

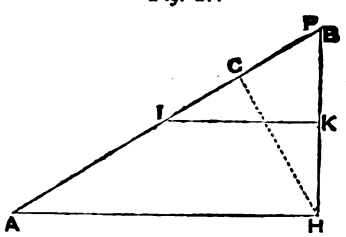
Fig. 26.



make it the diagonal of the parallelogram, we shall find that the space P C on the plane will be described by a body in the same time as it would occupy in falling down P F. We can therefore always ascertain the velocity of a body rolling down a plane, provided the inclination of the plane be known. The motion of a body descending an inclined plane is to that of free descent, as the height of a plane is to its depth. Thus if the length of this plane be 160 and its height 16, the ball will roll in one second, a distance of $1\frac{6}{10}$. Further as the force down an inclined plane is less than that which urges a body falling freely, the space through which a body must pass to attain a certain velocity must be just as much greater as the accelerating force is less. The body will therefore have the same velocity at the foot of the plane, as if it had fallen through its height.

Thus suppose the body to be placed at the top of the inclined plane, and from H (*Fig.* 27) draw the

Fig. 27.



line perpendicular to the incline; B H represents the force of gravity, and B C will represent the proportion of that force down the inclined plane. In order that the body moving down the inclined plane should have a final velocity equal to that of one which has fallen freely from B to H, it will be necessary that it should move down the plane through a space which bears the same proportion to B H as B H does to B C. Now the triangle A B H is in all respects similar to H B C, only on a larger scale, therefore the line A B bears the same proportion to B H as B H bears to B C. Hence the body acquires a final velocity in descending the plane which is equal to that which it would obtain in falling through a space equal to the perpendicular height of that plane.

A body on arriving at the bottom of an inclined plane will have acquired a corresponding uniform motion, or, in the same time in which it descended the plane it would traverse a space equal to twice the length of the plane (agreeably to the fourth law of falling bodies). If however on its reaching the point C of the plane A B C, a second plane of equal altitude should present itself, the body would begin to ascend this second plane with the velocity gained by coming down the other. Now this motion will be uniformly retarded, and as the force of gravity is opposed to the body's ascent, the degree in which it is retarded exactly corresponds with the acceleration in the previous descent. In this case the distance which the body will pass over in the same time is equal to that of its descent, that is, the body must ascend the second plane, to an equal height in the same time that it came down the first from A. On gaining

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this point it will lose all its velocity and will again descend under circumstances precisely similar to those which attended its first motion. This is also true of compound planes or of curves which we may regard as a series of infinitely small planes. We should thus in fact be possessed of a simple perpetual motion, were it not for friction and the resistance of the atmosphere.

There is, however, an important difference in the descent of a body on a curve, which is that the obliquity of direction, and therefore the effect of the force of gravity is constantly varying. The force therefore which urges the body, instead of being uniform as in the inclined plane, is here gradually diminished. The rate of this diminution depends entirely on the nature of the curve, and can be deduced from the properties of the curve by mathematical reasoning. It will not be advisable to go into the abstract calculations which are necessary in order to demonstrate the various motions which are effected by various curves, but simply to mention the fact that the curve down which a body will descend with the greatest rapidity is a cycloid, which is a curve described by a point on the edge of a wheel or disc rolled along a plane surface.

I have already stated that in these investigations friction is put out of the question. It therefore follows that in proportion as it is partially obviated in experiments so will the results accord with the theory. An oscillating body has perhaps the least friction of any arrangement, and as pendulums are such bodies and exemplify well accelerated and retarded motion we may briefly consider their properties, bearing in mind that the previous remarks as to a body moving in a curve will strictly apply.

When a body is placed on a horizontal axis, which does not pass through its centre of gravity, it will remain in perfect equilibrium only when the centre of gravity is immediateiy below the axis. If it be moved from this position, the body will oscillate from side to side until by reason of the atmospherical resistance and the friction of the axis, it comes to rest. A body so suspended and oscillating thus, is in fact a pendulum.

A distinction is made between the simple or mathematical pendulum and the compound or physical one. The first is considered as a ponderous body suspended by an inflexible line without weight. Such an arrangement cannot actually exist, because a line must possess weight, but the assumption is made in order to ascertain the laws of the motion of pendulums generally. All actually existing pendulums are compound pendulums, and in fact the name is applicable to any body so suspended that it may swing freely backwards and forwards. Galileo having observed the hanging chandeliers of lofty ceilings to continue vibrating, after any accidental disturbance, for a length of time and with remarkable uniformity, was led to investigate the cause of the phenomenon, and out of what had been uselessly before men's eyes in some shape or other from the beginning of the world, his powerful genius extracted the most important results. Independently of the light which the theory of the pendulum has thrown on the various branches of physics, the instrument itself with a few wheels attached to record its vibrations has now become a universal timekeeper.

I have stated that a pendulum can only rest in a perpendicular position. If moved from this position into any other whatever and then left free to fall, it moves backward and forward, going to an equal distance on each side of the perpendicular, ascending on the one side to a height equal to that from which it had fallen on the other. Its descent is owing to the attraction of the earth, while its ascent results from its inertia, and the final velocity acquired by its fall. A pendulum will therefore have an accelerated motion in its descent, and a retarded motion in its ascent. Gravitation being thus the cause of the motion of a pendulum, its operation is never suspended, and a pendulum would vibrate for ever, were not its oscillation finally overcome by those impediments which it has in common with all terrestrial motions.

The vibrations of pendulums are governed by their lengths, that is to say that if a pendulum be lengthened it will vibrate more slowly and *vice versa*. When two or more pendulums are made of precisely the same lengths, their vibrations are respectively performed in equal times. The reason why long pendulums vibrate more slowly than short ones may be familiarly stated to be that in corresponding arcs or paths, the shorter pendulum has a steeper line of descent than the longer pendulum. Now as a body falls four times as far either directly or on any uniform slope in two seconds as in one, a pendulum must be four times as long to beat once in two seconds, as to beat once in a second, and one of one-fourth the length will beat half seconds.

Thus we obtain the law, that the lengths of the pendulums must be as the squares of their times.

A seconds pendulum is one whose vibration occupies one second, and the length of such a pendulum for the latitude of London is 39·12 at the temperature of 62°.

The effective lengths of pendulums does not include the whole length of the system, but is measured from the point of suspension to what is called the point or centre of oscillation, the position of which varies as the matter composing the pendulum is distributed. To illustrate the position of this point, let us take this system of two balls, the upper ball being nearer the point of suspension has a tendency to oscillate more quickly than the lower one, this tendency is communicated by means of the rigidity of the wire to the lower ball and quickens its descent; again the lower ball has a tendency to vibrate slower than the upper ball, consequently it being fixed to the upper ball by the wire, has the effect of retarding it in its motion, so that the effective length of the pendulum, or that on which the time of vibration depends, will not be measured from the point of suspension to the position of either the upper or lower ball, but to a mean position between each. We thus see that this centre of oscillation depends very much upon the centre of gravity, which varies according as the weight is concentrated in the ball or distributed through a larger surface, as for instance along the rod. Thus if we add weight to the bob of a pendulum we make it vibrate slower, though we do not add to its length, because we bring down the centre of gravity and with it the centre of oscillation, and thus increase what is called the effective length of the pendulum.

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The centre of oscillation is usually below the centre of gravity, and is identical with the centre of percussion. If I take a stick or rod, I find that there is a certain point beneath which if I place my finger, the whole system is supported in equilibrium. This is the Centre of Gravity.

If I strike any body with one end of the stick holding the other end in my hand, I shall feel a jar; if however, I cause the blow to be struck, at about one-third of the length of the stick from the end, the whole force will be exerted on the obstacle, and I shall feel no jar. The same effect will take place, if I grasp the stick at one-third of its length and strike with the further end. This point is called the centre of percussion or oscillation, and depends for its position, on the manner in which the matter is distributed through the system; thus if it be accumulated towards the end, the centre of percussion or oscillation will be removed further in that direction.

The centre of oscillation and the point of suspension, are likewise convertible points, that is if the centre of oscillation be made the point of suspension, the former point of suspension will become the centre of oscillation, and the system will vibrate in the same time as before. If the point of suspension be identical with the centre of gravity, the time of vibration will be infinite, that is to say there will be no tendency to vibrate at all, but if a force be impressed the system will tend to revolve. Thus by lengthening the upper part of the pendulum and placing a weight at the upper end, by approaching this weight towards the point of suspension the vibrations will become quicker till it passes that centre, when they will again become slower. The effect of this upper weight is to remove the centre of oscillation to a greater distance. We may thus obtain a short pendulum which will vibrate as slowly as we please. This fact is applied in the construction of the Metronome, or musical time-keeper, which consists of a pendulum of this description kept in motion by clockwork. The upper ball is moveable, and thereby the pendulum is made to beat quicker or slower.

As gravity is the force which determines the vibration of a pendulum, any change in that force will alter those vibrations. And thus at the equator, where the gravity of bodies is lessened in a small degree by the centrifugal force arising from the earth's rotation, and also varies from the increased distance from the common centre of gravity, a pendulum vibrates more slowly than elsewhere, and must be made shorter to answer the same purpose. Corresponding results take place when a pendulum is carried to a mountain top, further away from the centre of the earth, which is the centre of attraction, or when carried to the bottom of a mine, where it is attracted by the matter above it as well as the matter beneath. These vibrations are likewise affected by the density of the earth, and extensive series of experiments have at different times been undertaken for the purpose of observing these variations.

It is desirable here to allude to an experiment which has made considerable stir in both scientific and pseudo-scientific circles; I allude to Foucault's experiment with a pendulum to show the rotation of the earth. Cursory observers have too readily supposed this experiment to be one easily understood, and perfectly satisfactory, and that very inexact class of gentlemen known as popular lecturers, in their desire to make a hit and produce an effect on their audiences, have left on the minds of those who have not gone more deeply into the subject, to say the least, very incorrect impressions.

This experiment of Foucault's depends for its action on the well-known law, that all moving bodies have a tendency to continue that motion in the same plane. This is more strikingly true of rotatory bodies than oscillating ones, but for the present we will confine our attention to the pendulum. Foucault, then, suspended a ball which he caused to vibrate. The plane of its vibration was found gradually to move with respect to the earth's surface, or more exactly with respect to a graduated table placed beneath it and moving with the earth. This may be illustrated by an experiment, in which a ball is suspended from a support, which is fixed to a table below. In whichever direction I move the table, you will observe that the ball still vibrates in the same direction, so that I may move the table and support completely round without changing its absolute direction. Now if a pendulum were suspended accurately over either of the poles of the earth, and caused to vibrate, its plane of vibration would remain absolutely fixed while the earth rotated, so that the pendulum would actually point out the time upon a graduated scale placed below it. This apparent rotation in 24 hours would only take place, however, at the poles. At the equator no apparent motion whatever would be noticed, and the time of rotation would vary with the latitude from absolute rest to once in 24 hours. In our own latitude the time occupied in a complete revolution ought to be about 32 hours.

Thus for the theory. Practice has not given such satisfactory results. Very careful experiments have been made, but the results have not been uniform. There are many reasons why it should be so. It is impossible in the first place, so to cause a pendulum to vibrate, that its plane shall be a rigidly mathematical line, and if it deviate form this into an elliptical one (which it is pretty sure to do), it will change its plane of vibration by a well-known mathematical law, which has been clearly laid down by Professor Airey. Added to this, we have to consider the varying resistance of the air, the effects producible by a want of perfect uniformity in the materials of which the pendulum is composed, and we have from accidental causes alone quite enough to vitiate the result. But when we add to this the alterations producible by varying density of the earth, the effects of currents of electricity and magnetism, it will, I think, be readily understood by those who at all understand the extreme delicacy and accuracy necessary in the investigation, that it is almost hopeless to expect a scientifically accurate result.

It may be well before leaving this part of my subject to allude to the fact, that, ordinary pendulums cannot be depended on for uniformity of motion, owing to the elongation and contraction produced by the alteration of temperature. All sorts of materials have been used for the rods of pendulums in order to counteract this tendency, but as all bodies more or less alter their dimensions by a change of temperature, it is evident that we can

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thus only obtain the merest approximation to an invariable pendulum. By adopting the principle of compensation however this may be effected with very great accuracy.

There is yet a modified motion in which gravity has a considerable and increasing influence. It is the motion of projectiles. Thus when a stone is thrown from the hand we have two forces operating upon it, the projecting force exerted momentarily by the hand, and the force of gravity, which gradually obtains increased power over the stone as the resistance of the air gradually destroys the originally propelling force. The course of the body is therefore a line becoming more and more curved till the projectile force is wholly exhausted, when the body falls perpendicularly to the ground. The size of this curve, and therefore the amount of its curvature, depends on the original projecting force; but the greatest force can never cause a body to move in a perfectly straight line either through the air or through space. A body projected horizontally moves in the direction of its projection, through a space equal to that which it would have passed through if acted upon by that force alone, but arrives at a point as much below that from which it started, as it would have reached had it fallen freely in the same time. A body projected horizontally reaches the earth in exactly the same time that it would have fallen freely from the same height.

All missiles, as shot, balls, or arrows, describe curves of this nature. In archery, proficiency depends on the practical knowledge of this fact, the line of the arrow when in the bow, is brought to an angle with the horizontal, dependant on the distance of the target and the strength of the bow; the point being more elevated as the distance increases or the strength of the bow decreases. In all these calculations, however, allowance must be made for the resistance of the air, which brings down a projectile much sooner than in a vacuum.

In order to make these lectures on Dynamics complete, it is necessary to glance rapidly at the effects of gravitation on the heavenly bodies.

This subject is an extensive one and would furnish material for many lectures. I must however, content myself with a mere recapitulation of the principal features, as far as connected with my subject.

We now proceed, then, to an enlarged field of observation, and our reflections and calculations take a corresponding aspect. Millions of miles are now our fractions, and thousands of millions our units. We sometimes pause to find ourselves calmly dealing with the vast masses of innumerable suns and calculating billions of years, as though they were but atomies and their lives. Amid such vastness and sublimity the mind may well become overpowered with a sense of its own feebleness and inability to grasp the mighty truths that surround it, and stretch away into the far-off depths of space. The attainments of the highest intellect, comprehensive though they may be, are, when compared with the open book of the universe, but as a single letter upon its boundless page.

Newton, by working out the laws of gravitation, not only discovered the cause and principle which maintains the frame of the universe, but by the reasonings of an exalted geometry, ascertained its law and intensity. His principle being then assumed by other philosophers, the calculated phenomena of nature were found to agree with observation, by which a conquest far above the circle of mere geometric truth was obtained, and the justness of the hypothesis from which they were derived established beyond dispute. Still the retardations of planetary motions sorely perplexed the astronomical world, and the knowledge requisite for their development was of tardy growth.

But in these days, the Newtonian theory of the mysterious influence of gravitation and attraction has been successfully carried to an extent beyond the warmest anticipation of its discoverer. "Those inequalities," says Laplace, the most gifted follower of Newton, in treating of the reciprocal attraction of the planets, "seemed formerly inexplicable by the law of gravitation, but they are now one of its most striking proofs. Such has been the fate of this brilliant discovery that every difficulty which has arisen became for it a subject of a new triumph, which is the most certain characteristic of the true system of nature. To have executed this task was an achievement which in its magnitude can be measured only by the infinite in space, and in the duration of its triumph by the infinite in time."

Newton accounted for the movements observed in the solar system from the principles of gravitation, combined with the laws of matter and motion deduced from observations on terrestrial bodies. Hence he saw that the sun, situated in the midst of the planets, attracts them all towards himself, while they also attract the sun; but from the greater mass of the latter the effect of the planets is comparatively small. Had no other impulse been given to each of these bodies they would have come together in consequence of their mutual attraction; but a proper impulse was given to each planet in a direction perpendicular, or nearly so, to a line joining the sun and the planet. These impulses must have been given at the creation, for they required, to use the words of Newton, "the Divine arm to impress them according to the tangents of their orbits." The celestial motions exhibit at once the existence of a power acting under different circumstances, a power originally impressed upon the bodies, and a power continually acting upon them. The motive forces likewise indicate an external cause, for no internal powers of a material body can give it motion, or when in motion alter its state of motion.

I have before stated, that this orb which we inhabit is composed of a number of variously constituted and arranged particles, each of which possesses the attraction of gravitation, which binds the whole into one mass. As this force acts equally in all directions, these particles assume a nearly globular form, not only in the case of our earth, but also in all the bodies through space.

This may be experimentally shewn in an apparatus which I have already had the pleasure of bringing before you to illustrate the properties of centrifugal force, on which much of the nebular theory of the formation of systems of planets is based. You observe that it is necessary in this apparatus, to isolate masses of matter from the attraction of the earth, so that they may be free to obey only the forces which apply to themselves.

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This is effected to a great extent by dropping oil into a mixture of alcohol and water of the same specific gravity. The result is that the various particles, obeying their own attraction towards themselves, are seen to take the globular form. The same thing is partially true of the drops of rain as they fall through the air, or of the dew-drop as it hangs to the blade of grass.

In the case of the heavenly bodies, there is another force which modifies the shape of the masses subjected to it; this is centrifugal force generated by a circular motion, and gives a flattened form to the orb. This may be shewn in this apparatus by communicating a rotatory motion to this globule of oil; if the motion be continued, a ring strikingly resembling the ring of Saturn is shown. If the motion ceases the mass again assumes the original form, obeying the attractions within itself.

Let us now apply this fact on the large scale:—let us suppose this terrestrial globe in its present state, subjected to a higher rate of rotatory speed than it at present possesses; the result would be increased flattening at the poles, causing doubtless a disturbance and disruption of the various strata which form its substance. If on the contrary its circular motion were to cease, the globe would doubtless, from the overwhelming force of gravitation, assume a perfectly spherical shape. It is not necessary that the earth should ever have been in a semi-fluid state, as some suppose, in order to account for its flattened form. On the contrary, if it ever had possessed that consistence, and was subject to the same velocity as at present, it would have assumed a still more flattened form, perhaps have possessed a ring like Saturn, or even had its component parts projected to an immense distance in space.

It was first systematically demonstrated by Sir Isaac Newton, that all the motions of the heavenly bodies may be deduced from the effects of the same force of gravitation which causes a heavy body to fall to the earth. He has shown that in consequence of this universal property of matter, all bodies attract each other with forces decreasing as the squares of the distances increase, and of late years, the same theory has been still more accurately applied to the most complicated phenomena.

The times of the revolution of the planets are found to be in perfect accordance with these laws, and Newton demonstrated that although most of their orbits are elliptical, that the time of revolution in an ellipsis is equal to the time of revolution in a circle of which the diameter is equal to the greater axis of the ellipsis.

I will here briefly indicate a few of the phenomena resulting from gravitation.

The universality of the laws of gravitation as applied to the different planets shows that the matter of which they are composed is equally subjected to its power, for if any of the planets contained portions of an inert substance, requiring a force to put it in motion and yet not liable to the force of gravitation, the motion of the planet would be materially different to that of any other planet similarly situated.

The deviation of each planet from the plane of its orbit, and the motion of its nodes or the point at which the orbit intersects the plane of the ecliptic, as well as the motions of the aphelion or the point where the orbit is most remote from the sun, have all been deduced from the attractions of the other planetary bodies, but the calculations of the exact quantities of their perturbations are extremely intricate.

The diminution of the obliquity of the ecliptic, or the angle at which it stands to the earth's axis of motion, is a slow variation of its position, which is only ascertained by a comparison of very distant observations, and is occasioned by a change of position of the earth's orbit, in consequence of the attraction of the other planets, especially of Jupiter. It has been calculated that this change may amount in the course of many ages to 10′ or 11° with respect to the fixed stars; but the obliquity of the ecliptic to the equator can never vary more than 2° or 3° since the equator will follow in some degree the motion of the ecliptic.

The actions of the sun and moon on the prominent parts about the earth's equator produce a slight change in the situation of its axis, in the same manner as the attraction of the other planets occasions a deviation from the plane of its orbit. Hence arises the precession of the equinoxes, or the retrograde motion of the equinoctial points, amounting to about 50″ annually, or one revolution of nearly 26,000 years. This movement was first discovered by Hipparclius 2000 years ago. Once revealed, the slow movement of the equinox makes it a fitting hour hand in the dial of the heavens with which to measure the revolutions of ages. As the sun's path has been divided into twelve constellations, each filling the twelfth part of the entire circuit of the heavens, for the equinox to pass the twelfth part of the dial, or from one constellation to the next, will require a period of more than 2000 years. Since the astronomer first noted the position of this hour hand on the dial of the stars, but one of its mighty hours of 2000 years has rolled away.

The nutation of the earth's orbit is a small periodical change of the same kind, depending on the position of the moon's nodes, in consequence of which, according to Bradley's original observations, the pole of the equator describes a little ellipsis, of which the diameters are 10″ and 20″.

It was determined by Halley and Clairaut, that the attraction of Jupiter and Saturn would delay the return of the comet of 1759 about 618 days, and the prediction was accomplished within the probable limit which they had assigned for the error of the calculation.

It was perhaps one of the greatest discoveries of the last generation that the perturbations of the planets are periodical or oscillating, that a planet after leaving its regular or mean path for a certain time returns slowly to that path, deviates from it on the other side, and again returns and passes to its former limit. Like a pendulum, these bodies in their onward course move now to one side of the mean line, now to the other, and although the oscillations in some cases amount to countless centuries, they are not less sure and fixed than those of the rod whose regulated motion marks a second of time.

I have in the course of these lectures spoken of the discovery of the planet Neptune, and I there-

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fore need merely allude to it as one of the greatest triumphs of mechanical science as applied to astronomy.

But there is another class of heavenly bodies moving in and belonging to our system which are affected at still greater distances. Argelander says that the splendid comet of 1811 requires 3065 years for its revolution; whilst Encke fixed 8800 years for the awfully grand one of 1680. These bodies therefore, recede respectively 21 and 44 times farther from the sun than Uranus, that is 8400 and 17,600 millions of miles.

The sun's attractive force, therefore, extends even to this enormous distance; but its diminished effect is shown by the velocity of the comet, for whilst that of 1680, at its perihelion, or nearest point to the sun, travels at the rate of 53 miles per second, or 18 times faster than the earth, its velocity scarcely attains 10·8 feet per second at its aphelion.

How mighty must be the force which can act at such remote distances, which can govern such immense masses, and which can produce such accurate results. A magnet which can attract at the distance of a few inches, is spoken of with wonder; but here we have attraction producing appreciable effects at a distance of 17,600,000,000 of miles!

But not only do we learn that our own earth is retained in its orbit, that the permanence of its form is ensured, that the other planets are governed by the same law and subject to the same influence, even to the remotest circle of our system, and that those mysterious comets that ever and anon astonish and startle us by their brilliancy are likewise bound by the same invisible but potent bond of union, but we find that its influence is still farther felt and obeyed.

If we yet enlarge our observations, we shall find that throughout boundless space this unseen and all pervading power is still active. Our earth is the merest point, our system only a speck, when compared with those illimitable fields through which suns are strewn like grain as it falls broadcast from the hand of the sower.

Observation has proved that our sun, and with it the whole solar system, is not stationary, but that it moves with regard to the so-called fixed stars in a certain direction. As we know of no straight-lined motions in space, it is pretty certain that this motion is in a curve; and Professor Madler believes that he has discovered the centre of this curve, and is therefore able to calculate the orbit of our system, which he asserts requires 18,000,000 of years for its completion.

This is but a mere enumeration of a few of those mighty truths which meet our view when we look beyond the narrow circle of our own interests into the vast expanse which lies beyond. Each discovery lifts the veil and disperses the mist, but to reveal a boundless prospect teeming with wondrous details, and to show us how little, how very little, we yet know.

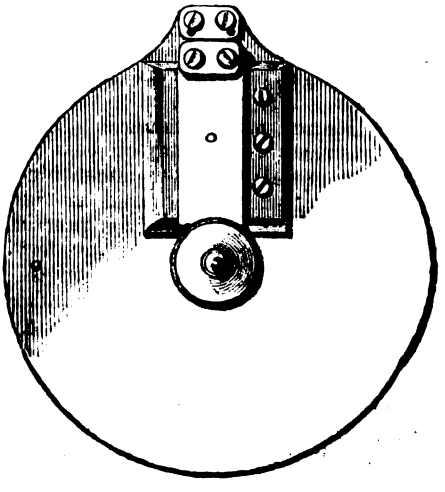
We may, in conclusion, remark the sublime universality of dynamical laws. We have together seen how the same rules that govern the particles of dust that float in the rays of the summer sun as they enter our apartments, also control those mighty orbs that whirl with the velocity of lightning through the infinite depths of space, and the same forces which give a direction of motion to the apple as it falls from the tree, bind together into one infinite and harmonious whole, not merely a world or a collection of planets, but the vast illimitable universe of God. In the words of a recent writer: "If by any mechanical means, we disturb the gravitating principle which binds even the drop of water together, this disturbance, acting by successive impulses from mass to mass, would be communicated to every one of the myriads of orbs which are under its eternal influence. The blow which reduces a stone to powder, pendulates through space; and the poet's fancy, that the remotest worlds have shuddered at the deeds of men, is only another form of expressing a strictly philosophic truth. There are no limits to the powers of gravitation. From the immensely vast to the infinitely small it extends its powers, and, modified by others of the mighty forces of creation, the solar system is held together in the bonds of its attraction, and with every other system of the universe is bound in indissoluble chains to some common centre, far beyond the reach of philosophy with all its refinements.

In our next Lecture we enter upon the consideration of the Mechanical Powers.

DESCRIPTION OF ROBERTS'S ECCENTRIC METAL GAUGE.

By the Inventor.

A circular brass casting, as seen in the drawing, $4\frac{3}{4}$ in. diameter, having a boss at



the back, is recessed in the lathe to the depth of $\frac{1}{4}$ of an inch; the diameter of this recess is 4 inches; concentric with the recess is drilled a hole in the brass casting. A circular plate of steel is procured about 4 inches diameter and $\frac{1}{12}$" thick, in which a hole is drilled about $\frac{3}{8}$ diameter and $\frac{1}{10}$ in. out of

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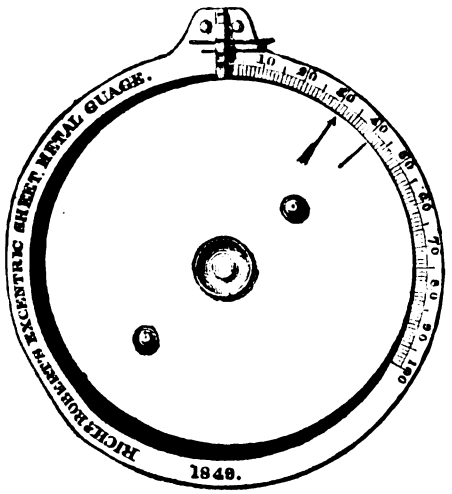
centre; into the plate a steel pin is turned to fit the hole in the plate and the brass; the steel pin is provided with a large flange-like head secured to the plate with three screws; the plate is turned $\frac{1}{10}$ in. eccentric to its pin until it will just enter the recess in the brass casting; upon the back of the brass is a steel slide, from which projects upwards through the brass, a "steel jaw" which is thrust inwards against the plate by a spring lying at the bottom of the recess.



To a lateral projection of the brass is secured a fixed steel jaw, which, when the steel plate presents its largest radius to the sliding jaw, the fixed jaw is secured in contact with the sliding jaw; both jaws must be very accurately finished so as to prevent the light passing between them. There are two studs riveted into the steel plate for the purpose of turning it. The margin of the brass beyond the recess is divided into 300 equal parts, commencing at the centre of the fixed jaw; and as the gauge would be too fine for any practical purpose if marked from the greatest radius of the steel plate, I merely use the centre mark for adjusting the gauge, after which I mark it at 10 points to the right from the longest radius, and call that No 1, which is fine enough for gauging the finest balance spring. After No 1 the succeeding numbers increase by accelerating increments up to 75° after which the reverse will be the case. Numbers beyond 75° will seldom be required in the watch trade, therefore the evil will not be of much consequence up to 100° which is as far as is desirable to engrave it.

ATMOSPHERIC PRESSURE IN THE TROPICS.

The seventh number of Meteorological Papers, issued by the Board of Trade, contains an Investigation into the Diurnal Range of Atmospheric Pressure in the North Atlantic, between the parallel of 10°N and the equator.

The observations employed were obtained from marine barometers which were thoroughly tested and verified at Kew Observatory. It results from the discussion that in the specified region of ocean, daily *maxima* pressures of the atmosphere occur about 9h. 28m. am. and 9h. 47m. pm.; and *minima* at 3h. 47m. a.m. and 3h. 54m. p.m.; the following being the amounts by which the pressure of the air at each hour of the day differs from the mean pressure during the day of twenty-four hours, being general averages for the year, the number of observations not having been sufficient to give the diurnal range for every month.

A.M. Hour.	Inches.	P.M. Hour.	Inches.
1	+·002	1	−·007
2	−·009	2	−·022
3	−·016	3	−·032
4	−·017	4	−·035
5	−·011	5	−·031
6	−·001	6	−·020
7	+·012	7	−·006
8	+·023	8	+·008
9	+·029	9	+·019
10	+·029	10	+·023
11	+·021	11	+·021
12	+·008	12	+.013

These quantities applied to the barometer readings, reduced to 32° F. at the sea level, taken at the respective hours, will give approximately the mean atmospheric pressure, as shewn by the particular barometer.

Moreover it is stated, that, "Near the equator (or, rather, at about 5°N latitude in the Atlantic Ocean), the *total* pressure on the barometer varies so little throughout the year, that, (allowing for the six hourly change) any ship crossing that part of the sea, may actually compare her barometer with a natural standard: invariable within known small limits of two or three hundredths of an inch, a margin not greater than is allowable in using a marine barometer afloat, after it has been conveyed from the place of exact testing on land."

From a table of mean monthly pressure on the barometer, the following is compiled.

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Month.	Mean Barometer, in the Atlantic.	
	10° to 5° N.	5° to 0° N
January .	29·91	29·88
February.	29·94	29·91
March. .	29·94	29·93
April . .	29·95	29·94
May . .	30·00	29·96
June. . .	30·01	30·00
July . .	30·01	30·03
August . .	30·01	30·01
September	29·99	29·99
October. .	29·99	30·00
November	29·95	29·94
December	29·93	29·93

These results are deduced from English observations, made with carefully verified instruments, with the exception of January and February, which are from the Dutch. The means of Dutch observations are given along with the English; but, being in almost every case lower than the latter, their accuracy is doubted.

By the known mean monthly pressure, and the diurnal range, a correction may be obtained for barometrical observations made on board any ship crossing this region, hereafter or in any former year: the limit of error it may be repeated not being greater than that allowable in ordinary observations made by various persons, at night as well as by day, on board a ship in motion. With respect to the diurnal range it is said, that having been derived from observations made between latitude 10°N to equator, longitude 20° to 30° w, and in various months, it cannot be taken to apply exactly to places out of that space; and to individual months, although probably it is approximately true for the intertropical ocean generally, and for each month.

A comparison, or correction, of barometrical observations made in the specified region of the Atlantic may be ascertained in the following manner. Having reduced the observations to 32° and the sea-level, apply to each the amount of range corresponding to the hour of day, with the reverse sign, the results will be so many approximate mean pressures, and their average should equal the mean monthly pressure as given in the table. Should there be any difference it may be considered the barometer error; and, if deduced in this way for every day the ship is in these latitudes, will on the average be very near the truth; and will, at least, certify to the correctness of the instrument to within (at the utmost) five-hundredths of an inch; at about 30 inches of the scale.

It should be remembered that this proceeding will exhibit the scale error at about 30 inches only. At 28 or 31 inches it is very likely to be different, especially for common barometers in wooden frames, but will depend upon the relative calibre of the cistern and the scale part of the tube, in other words it will be due to "capacity."

This, then, is a scientific process by which the navigator, or the meteorologist, is enabled to test the accuracy of barometer records of long sea voyages.

As in the present state of the art of navigation, the true positions of so many hundreds of landmarks having been accurately determined, the mariner can by them check the time shewn by his chronometer with very little difficulty on almost every voyage, and hence estimate the dependance which he can place upon it; so now he has a method of satisfying himself as to the correctness of his barometer.

The table of monthly mean pressures, in its present state, cannot be accepted as being so good as it could be made. The number of observations, from which it has been constructed is far from numerous. The means deduced from thousands, instead of hundreds, of observations, would form a very reliable and satisfactory table.

Here is an example of the use and value of these tables. The ship had a barometer in a wooden frame, with a large scale error.

Month. 1861—2.	Latitude N.	Mean Bar. corrected for Temp. and Range.	Mean Monthly Pressure.	Scale Error of Barom.
October	10° to 5°	29·45	29·99	+·54
,,	5 to 0	29·50	30·00	+·50
May	0 to 5	29·40	29·96	+·56
,,	5 to 10	29·47	30·00	+·53

The average of these +·53, is consequently the probable error of the barometer at 29·5 inches.

The importance of being able to detect so large an error, within two or three hundredths of an inch, must be obvious. S.

ALLOYS OF ALUMINIUM.

Two alloys of this metal have been manufactured at Newcastle: namely, Copper 95, Aluminium 5; and Copper 92½ to 7½ of Aluminium; and called by those working them Aluminium Bronze. We have examined both proportions, and give preference to the 7½ per cent., especially for colour.

The hardness appears quite equal to the best brass, while the colour is that of rich gold; it takes a high polish, and appears to work soundly.

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We recommend experiments with this latter, namely, 7½ aluminium bronze, to our readers and suggest that particular attention be paid to the effect of atmospheric moisture, with varying temperatures, as it is represented not to tarnish. If such be the case, its employment for the frames of watches and chronometers might save much labour and expense.

THE GREENWICH TIME WIRE.

To the Editor of the HOROLOGICAL JOURNAL.

Sir,—Can you afford any information touching the reason for the apparent failure of the well-known economic principle of "supply and demand," exhibited in connection with the subject whose title heads this letter.

It is now *Years* since The London District Telegraph Company announced, by circular, that they were prepared to supply electric signals for the use of chronometer makers, under arrangements with the Astronomer Royal, and soliciting custom.

I judge by the haste I deemed it prudent to make, in forwarding my own application, that many others must have *applied* immediately, seeing that the *article* offered, *namely accurate Greenwich Time*, is indispensable, and had never been procurable with either sufficient accuracy or facility. Some months since, there again appeared in the local paper an advertisement stating that the "wire was now laid on, and could be seen at work at the residence of Mr Johnson in Wilmington Square."

This was possibly true enough, but what I wanted was to see it working at my own house, and for which I had agreed to pay the company's own price.

Subsequently a clerk has been to my office asking if I were willing to pay the charge for laying the wire on to my premises, namely, Five Pounds (the receiving instrument to be my own property and found by myself), which I need scarcely say I answered in the negative.

Up to this moment I know of no one supplied by the company, although I noticed an advertisement in your journal offering for sale a "Transit Instrument" of such dimensions that, if complete, the price asked would be scarcely a quarter of its cost price, indicating that its use was no longer required, and leading to the belief that the dirty water was being thrown away before the clean was secured.

The information I seek will doubtless be acceptable to a great number of your readers, as well as to, your obedient servant,

CHRONOMETER MAKER.

NEW BOOKS.

Mr. Charles Frodsham has just published a pamphlet entitled "Elements of Clock and Watch Making," announced as a part of a series, or of a larger work yet to come.

It consists principally of Tables, and reductions to weight and measure of the various indispensable parts of Timekeepers, a very useful and promising labour.

We refrain from criticism until the work is complete. At the same time we hail with pleasure any promise of such a text book as the art demands and which other scientific trades have long possessed.

ABRIDGMENTS OF SPECIFICATIONS OF PATENTS

RELATING TO WATCHES, CLOCKS, AND OTHER TIMEKEEPERS.

(*Continued from page* 10.)

1848, July 11.—No. 12,207.

ROBERTS, RICHARD.—1. The application of the influx and efflux of the tide for effectuating, directly or indirectly (by hoisting weights for that purpose) the motion of clockwork.

2. Arrangements in connection with turret and public clocks, whereby the difficulty of placing the "guide pulley" at such a distance from the barrel as will admit of an equal distribution of the cord or chain throughout its entire length is avoided, and by which arrangements two or more chains may be actuated by one weight and one cord, the effect of which shall be equimotive at all times.

3. Apparatus whereby the time shown by the dial of one clock can be shown at other dials simultaneously.

4. Imparting equimotive impulses to clock escapements, and compensating for the effects produced by change of temperature on the pendulum rod.

5. Causing the hands of timekeepers to be advanced at definite intervals of time, which shall correspond with a certain definite number of oscillations of the pendulum.

6. The construction of and application to clocks of a transparent cycloramic dial or index.

7. The adaptation of toothed sectors and other apparatus for effecting the striking of the hours and quarters, the same being substituted for the ordinary trains made use of for such purpose.

8. Relates to compensation balances adapted for pocket and box chronometers.

9. Escapements for chronometers and watches whereby the motive power is regulated so as to impart equimotive impulses to the balance. An extra hair spring is used, and the agency of the fusee may be dispensed with.

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10. Enabling chronometers and watches to beat dead seconds with the ordinary train of wheels only.

11. Mechanism by which the duration of intervals of time may be ascertained, without affecting the motion of the timekeeper.

12. A machine called "a normal drill" for the purpose of drilling and boring with accuracy frame plates and other parts of timekeepers.

13. Hardening and polishing frame plates.

[Printed, 4s. 9d. See Mechanics' Magazine, vol. 50, p. 67; Artizan, vol. 7, pp. 133 and 232; and Patent Journal, vol. 7, pp. 17 and 59.]

1849, April 16.—No 2567.

SHEPHERD, CHARLES. — "Improvements in working clocks and other timekeepers, telegraphs, and machinery by electricity."

1. The application of electricity to winding up the impulse spring or weight in the remontoir escapement. The apparatus for giving the impulse consists of a bar magnet supported by a spring attached to a bracket. The spring from its point of junction with the bar magnet is continued in the form of a rigid bar. An electro-magnet causes the bar magnet to oscilate carrying the bar with it. The remontoir or impulse giver is a rigid bar supported by a spring attached to the aforesaid bracket. When the bar magnet oscillates, a pin on the bar upon it comes in contact with the remontoir spring, carrying it to the full extent of its motion, when the extreme end of the remontoir spring slips under a detent, where it is locked until released to give the impulse. This detent is unlocked by the point of a screw passed through the pendulum; the impulse spring being released falls on the point of another screw in the pendulum rod and gives the impulse, and after doing so rests on a banking screw until the like action is repeated by the oscillation of the bar magnet. The completion of the current is effected by the contact of a platina piece on the pendulum with the end of a spring fastened to an insulating bracket, the end of the spring carrying a platina pin. The patentee also applies the above when a weight is used.

2. Giving audible signals by means of a locking plate and apparatus connected therewith, actuated by electro-magnetism. The first mover consists of a pair of pallets supported on an oscillating axis, which pallets at each oscillation cause a ratchet wheel on the arbor of the seconds hand to rotate the distance of half a tooth at each movement of the pallets. To the oscillating axis are attached two bar magnets the ends of which are alternately attracted and repelled by two electro-magnets whereby motion is given to the pallets. The seconds wheel revolves once in a minute and carries a projecting pin; the minute wheel also carries a pin and revolves once in an hour. Once in an hour therefore these pins are at similarly relative positions. When this happens the secondly-mentioned pin causes an arm working on a pivot to come in contact with the first-mentioned pin, and then the poles of an electro-magnet attract an armature and thereby lift a detent from the locking plate, on whose arbor is a ratchet wheel, into whose teeth work two pallets; and the arbour of these carries an arm supporting an armature over a second electro-magnet. When the detent is lifted from the locking plate one end comes in contact with a platina point in a plate above it, and the whole circuit is complete, and the ratchet wheel is moved until the detent falls again into a notch of the locking plate. The last mentioned arbor carries a hammer.

3. A method of diminishing the oxidation of the platina points. A glass vessel is supported from the pendulum rod, and in it is suspended a weight. Break points are introduced through the sides of the glass vessel, and come in contact with the weight as the pendulum, and the glass with it, oscillate. The vessel contains hydrogen, in order that the platina points may not be oxidised.

4. The impulse or remontoir spring is supported in a bracket as above mentioned, and at the other end branches into two arms, one of which acts on the impulse pallet in the large roller, and the other on a detent furnished with a discharging spring, as in the ordinary escapement. An arbor in the centre carries the two bar magnets, the arm which carries the "winding up" pin of the impulse spring, and also an arm which carries a pin for moving a detent for the purpose of breaking contact between the platina points of two springs, and thereby breaking the electric current.

5. "An improved escape wheel and pallets." The driving arm in connection with the bar magnet, is divided into four points of contact, two of which act as driving pallets, and two as detents to the escape wheel teeth. The above may be applied to actuate telegraphic hands or pointers.

[Printed. 2s. See Mechanics' Magazine, vol. 51, p. 328; and Patent Journal, vol. 8, pp. 43 and 46.]

1849, June 12.—No 12,656.

PREDDY, WILLIAM.—Closing the pipes of watch keys when not in use. The patentee does this in various ways, such as:—by having a sliding square or piston inside the pipe of the key, which is kept in its place when not being used by a spiral spring above, or by a spring at the side, or by having a moveable sheaf or stopper; or by having a square piston fitting the pipe, having a thumb piece by which it is pulled up or pushed out as required. The latter plan is most applicable to the keys of clocks.

[Printed, 5d. See London Journal (*Newton's*), vol. 35 (*conjoined series*), p. 410; Mechanics' Magazine, vol. 51, pp. 573 and 588; Artizan, vol. 8, p. 40; and Patent Journal, vol. 8, p. 163.]

1849, July 18.—No 12,711.

BROWN, WILLIAM, SHAPPLE, HENRY, and WILLIAMS, WILLIAM.—"Improvements in communicating intelligence by "means of electricity, and improvements in electric clocks."

[No Specification enrolled.]

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1850, February 28.—No. 12,983.

PEPPE, George Tosco.—A method of regulating the descent of a column of mercury contained in a glass tube, by causing its rate of motion to depend on the air beneath the mercury in the tube passing by a regulated orifice to the portion of the tube above the mercury; and the application of this regulated motion to indicate equal portions of time.

[Printed, 5*d*. See Repertory of Arts, vol. 16 (*enlarged series*), p. 282; London Journal (*Newton's*), vol. 37 (*conjoined series*), p. 168; Mechanics' Magazine, vol. 35, p. 178; and Patent Journal, vol 9, p. 270.]

1850, October 3.—No. 13,268.

TIFFEREAU, Cyprien Theodore.—"Improvements in Hydraulic Clocks." 1. The application of a syphon set on a floating board. As the water is taken from one vessel to another, by the agency of the syphon, the sinking of the latter shows the result on a graduated dial or scale.

2. The application of a "syphon bowl which is set flowing by the peculiarity of its configuration, and gives directly a swinging motion by filling up and emtying itself." Attached to this bowl is a lever, which, by the intermediate aid of an arm, communicates the motion to a lever which oscillates on the centre of a clock dial placed above, and thus moves the hands by the aid of usual clock wheels.

3. The application and use of the bowls or cups, which are adjusted to both branches or arms of the syphon, having small holes in them, and which, at the same time that they regulate the flowing out, keep up constantly the running-off action of the syphon.

[Printed, 10*d*. See Loddon Journal (*Newton's*), vol. 38 (*conjoined series*), p. 323; Mechanics' Magazine, vol. 54, p. 299; Practical Mechanics' Journal, vol. 4, p. 36; and PatentJ ournal, vol. 11, p. 14.]

1851, March 17.—No 13,558.

MINTON, Herbert, and HOFFSTAEDT, Augustus John (*partly a communication*). — 1. Manufacturing faces or dials of plastic clay or other analogous plastic material.

2. Manufacturing them of powdered clay, or other analogous compound or substance by pressure. The requisite devices for the faces may be applied by any of the well-known printing or painting processes.

3. The application of the process employed in the manufacture of encaustic tiles to the manufacture of faces or dials.

[Printed, 3*d*. See London Journal (*Newton's*) vol. 40 (*conjoined series*), p. 109; Mechanics' Magazine, vol. 55, p. 257; Artizan, vol. 9, p. 263; and Patent Jonrnal, vol. 11, p. 303].

1851, April 10.—No. 13,587.

M'DOWELL, Charles.—"Improvements in the construction of timekeepers." In the forms set forth in the drawing to the specification, the invention is shown in the substitution of an excentric pin or a one-toothed wheel in lieu of the ordinary escape wheel. The patentee does not confine himself to any particular modification, but states that his new escapement has this peculiarity: viz.—"that it will impart an impulse to the pendulum or balance while in the middle of its vibration chiefly by a direct instead of an oblique action."

[Printed, 6*d*. See London Journal (*Newton's*) vol. 40 (*conjoined series*), p. 16; Mechanics' Magazine, vol. 55, p. 318; and Patent Journal, vol. 12, p. 24.]

1852, May 29.—No. 14,146.

BAIN, Alexander.—The only part of this invention that relates to clocks consists in improvements in electric clocks and timekeepers; the improvements consisting in causing the system of clockwork that gives motion to the magnets to be constantly controlled and regulated by a second system of clockwork.

[Printed, 2*s*. 3*d*. See Repository of Arts, vol. 21 (*enlarged series*), p. 137; and Mechanics' Magazine, vol. 57, p. 476.]

1852, October 2.—No. 40.

HOLL, Frederick Richard.—This invention consists:—1. "Of the use of a strong bent spring, fixed at one end and connected at the other to a bent arm, which carries a rolling surface, which by acting on a curved rack moving on a centre gives motion to that rack, which gives motion to a pinion, which in turn gives motion to the other parts of the works." The peculiarity of the above consists in using the frame as the part to contain the power; which motive-power is a short bent spring, which only requires to be bent to a curve of smaller radius by leverage, instead of a long spring that requires winding up. As the spring decreases in power, the leverage becomes more favourable, so that the power required for each tooth of the curved rack is nearly equal.

2. "Of an improvement of the chronometer escapement, by which the locking spring is acted on through a diagonal attached to it, in place of being acted on directly at its end."

[Printed, 7½*d*.]

1852, October 2.—No. 147.

WHELE, EDWIN.—1. Relates to apparatus to burn candles so as not to require snuffing, or to be self-snuffing.

2. Relates to a lamp where the candle is made to consume at a regular rate, by the application of more equal pressure for the purpose of keeping the candle up to the nozzle of the lamp. This is done by weights attached to the push up and working over pullies; or by elastic bands attaching the nozzle to the push up; or by a spiral spring under the push up; or by the application of pullies combined with other springs.

3. By means of his aforesaid lamp the patentee applies the upward movement of the candle to turn the hands of a dial or clock face and to show the time and to ring or strike an alarum and strike the hours.

[Printed, 6½*d*.]

(*To be Continued.*)

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., AUGUST, 1862.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	30·057	62	58	72	55·5	S	2	b	b
2	30·006	63	59	76	55	WNW	3	o	cb, r
3	30·100	61	56	71	53	NW	1	b	bc
4	30·041	61·5	56	71	55	SW	2	cb	bc, r
5	29·703	64	57	72	60	SW	5	cb	bc, r
6	29·793	61·5	54	71	54	W	5	cb	crq
7	29·393	61	59	66	57	SSW	8	or	r, cb
8	29·515	59·5	55	67	54	W	4	c	r, c, r
9	29·728	58·5	54·3	63	54·5	NW	4	cb	c
10	30·007	58·5	54·5	65	50	NW	2	o	c
11	30·130	60	55·5	64	55	NNW	1	co	c
12	30·170	62	56	65	55	NW	2	c	cb
13	30·013	61	57·5	67	55	W	3	o	c, rr
14	29·797	60·5	59	67	57	SSW	1	o	r, cb
15	29·809	60·3	58	65	57	SW	2	o	r, bc
16	29·830	61	59	62	55	NNE	2	o	rr
17	29·804	59	58	63	56	NNE	4	r	rr
18	29·948	57	55	60	55	N	2	o	o, b
19	30·002	58·3	56	61	51	WNW	2	bm	b
20	30·038	58	56	70	54	Calm	0	bm	b, om
21	29·965	62	60·5	67	59	Calm	0	f	c, r
22	29·903	59	57	68·5	57·5	NW	2	mo	cb, b
23	30·180	57·5	54	68	50	NW	3	b	bc
24	30·287	57·5	53·5	67	50	N	1	cb	cm, b
25	30·300	59·5	56	64·5	50	SE	3	b	b
26	29·953	61	58	69	54	SE	4	b	b, cb
27	29·973	60	58	71	56	NE	3	bc	b
28	30·130	58·5	56	70	54	NE	2	bc	bc
29	30·165	61	58	70	55	NNE	2	o	co
30	30·137	59	56	66	51	N	2	c	cb
31	30·100	60	57	65·5	57	SE	2	cm	cb
	29·967	60·9	56·6	67·3	54·6		2·5	Mean.	

REMARKS.

The highest reading of the barometer was 30·323 at midnight, 24th; the lowest 29·393 at 9 a.m. 7th; hence the range was, at least 0·93 inch.

On the 7th a strong south-westerly gale prevailed with a little rain, throughout the civil day.

There was constant rain almost the whole of the 16th and 17th, the wind being NNE light to moderate.

At 9 a.m. 17th, 0·58 inch was in the gauge; and at 9 a.m. 18th, 0·86 inch.

Rain fell on 12 days, during about 72 hours, to the amount of 2·45 inches; three-fifths of it falling on the 16th and 17th.

From the 9 a.m. observations, it appears, the wind blew from N, 10 days; E, 4; S, 5; and W, 10.

EQUATION OF TIME TABLE

FOR OCTOBER, 1862.

Day of the Week.	Day of Month	At APPARENT NOON. Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *added* to Mean Time
		m. s.	s.	m. s.
Wed..	1	10 17·11	0·790	10 17·25
Thurs.	2	10 36·08	0·778	10 36·21
Frid..	3	10 54·75	0·765	10 54·89
Sat...	4	11 13·10	0·751	11 13·24
Sun...	5	11 31·12	0·736	11 31·26
Mon..	6	11 48·79	0·720	11 48·93
Tues..	7	12 6·07	0·703	12 6·22
Wed..	8	12 22·95	0·685	12 23·09
Thurs.	9	12 39·40	0·666	12 39·53
Fri...	10	12 55·39	0·646	12 55·53
Sat....	11	13 10·91	0·626	13 11·05
Sun...	12	13 25·93	0·605	13 26·07
Mon..	13	13 40·44	0·582	13 40·58
Tues..	14	13 54·41	0·559	13 54·54
Wed..	15	14 7·82	0·535	14 7·94
Thurs.	16	14 20·65	0·510	14 20·77
Fri...	17	14 32·88	0·484	14 33·00
Sat....	18	14 44·49	0·458	14 44·60
Sun...	19	14 55·48	0·431	14 55·58
Mon..	20	15 5·83	0·404	15 5·93
Tues..	21	15 15·52	0·376	15 15·61
Wed..	22	15 24·54	0·348	15 24·63
Thurs.	23	15 32·88	0·319	15 32·97
Fri...	24	15 40·54	0·290	15 40·62
Sat...	25	15 47·49	0·260	15 47·56
Sun...	26	15 53·73	0·230	15 53·79
Mon..	27	15 59·25	0·200	15 59·30
Tues..	28	16 4·04	0·169	16 4·09
Wed..	29	16 8·09	0·138	16 8·13
Thurs.	30	16 11·39	0·106	16 11·42
Fri...	31	16 13·93	0·074	16 13·95

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MECHANICS.

Ninth Lecture delivered to the BRITISH HOROLOGICAL INSTITUTE.

BY W. HISHOP, ESQ., F.R.A.S., HON. SEC.

(*Continued from page* 18.)

Division* 3.—*The Mechanical Powers or Elements of Machinery: The Lever, and Wheel and Axle.

Nature has placed at our disposal various mechanical agents of different powers and properties. The weight of solid bodies, and their momentum when in motion, the weight and pressure of liquids, the weight and pressure of air and other gases, the elastic force of vapour raised from liquids by heat, the elasticity of springs, and the muscular strength of animals, furnish numerous examples. In applying these forces to any purpose, such as communicating motion, or, in other words, performing a certain amount of work, they almost invariably require certain modifications before they are capable of accomplishing the ends in view. The power may not act in the proper direction, or it may not have that velocity and intensity which suits our purpose, and some contrivance must be found by which, in its application to the working point, its direction, velocity, and intensity may be regulated in such a manner as to be suitable to the purpose for which it is to be applied. Thus, the even onward course of the stream or wind is modified, by the waterwheel or windmill, into rotatory or reciprocating motion, according as such motions may be required. The muscular power of a horse is applied through a machine for the raising of weights or water, or the tempering of clay for bricks. The expansive force of steam is governed and modified in an endless variety of ways, according as slow or rapid revolution or backward or forward motion is desired. The falling of a weight is made to keep a pendulum in motion in clocks, and the unbending of a spring is modified in its velocity and intensity in watches, till the desired rate of speed is at length attained.

No form or combination of machinery ever did or ever can increase in the slightest degree the actual quantity of power employed. Ignorance of this is the hinge on which most of the dreams of mechanical projectors, and especially of perpetual motionists, have turned. No year passes even now in which many patents are not taken out for such supposed discoveries; and the deluded individuals, after selling perhaps even their household necessaries to obtain the means of securing the expected advantages, often sink into despair when their attempts, instead of bringing riches and happiness, end in disappointment and ruin. The frequency, eagerness, and obstinacy with which even talented persons, owing to their imperfect knowledge of this part of natural philosophy, have engaged in such undertakings, is a remarkable phenomenon in human nature.

All the contrivances to which I have alluded, which are interposed between the moving force and the working point, or the point at which the power or motion is required, are called machines, and every machine, however complex it may be, must consist of a number of simple machines, which are commonly called "the mechanical powers."

For the reasons before stated, however, this term is not correctly applied to these elements. They are not "powers" or sources of force; they simply transmit and diffuse or concentrate forces.

These which may therefore be more correctly denominated "the elements of machinery," consist of the following—the lever, the wheel and axle, the pulley, the inclined plane, the wedge, and the screw. As some of these six machines are identical in principle and different only in appearance, this classification may be still further simplified into three—1st, The lever, with the wheel and axle; 2nd, The pulley; 3rd, The inclined plane, with the wedge and screw.

First in order, then, is the lever, to the consideration of the principles of which, with the wheel and axle, we shall now devote our attention.

Archimedes said, "Give me a lever long enough, and a prop strong enough, and with my own weight I will raise the world." But in order to do this, he would have required to move with the velocity of a cannon ball for millions of years, to alter the position of the earth by the small space of one inch. But, as I have stated in a former lecture, this feat of Archimedes (that is the moving the earth) is performed without the aid of the lever by every man who leaps from the ground; he kicks the earth away from him when he rises, and attracts it again when he falls back.

Perhaps the most general and most correct definition of the lever is, that it is any solid body having a fixed axis on which it turns or is capable of turning, and round which all its parts describe circles or parts of circles. In considering such a machine as applicable to mechanical purposes, we usually conceive its axis to be placed at right angles to the plane in which the power or weight and resistance act.

A lever considered as a bar or rod supported on a prop or fulcrum, is of three kinds, according to the position of the power and weight with regard to the prop. If the prop be in the middle of the lever, it is said to be of the first kind, if the weight be in the middle, it is of the second kind, and if the power be in the middle, it is a lever of the third kind.

1. A lever of the first kind is represented in *Fig.* 28.
2. A lever of the second kind is shown in *Fig.* 29.
3. And of the third kind in *Fig.* 30.

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Fig. 28.

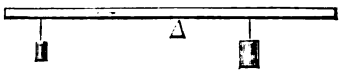


Fig. 29.

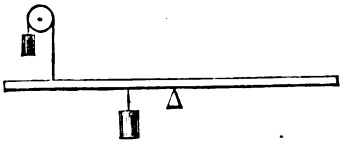
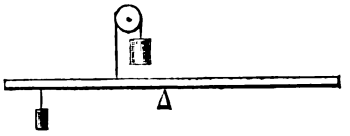


Fig. 30.



The mechanical efficacy of the machine increases as the distance of the power from the prop is increased, and as the distance of the weight from the prop is diminished. There will be an equilibrium in a straight lever of any kind when the power is to the weight as the distance of the weight from the fulcrum is to the distance of the power from the fulcrum. Thus, if the power be 1, the weight 2, the distance of the weight 3, and the distance of the power 6, equilibrium will exist. This experiment also proves that a power acts more efficiently against a weight in proportion as the power is more distant from the fulcrum. Also that two equal masses acting in opposite directions on the same lever cannot be in equilibrium, except when they are equally distant from the fulcrum. Also that two unequal weights exert equal forces when the distance of the smaller weight from the fulcrum exceeds the distance of the large weight from the same as much as the large weight exceeds the small one.

In a lever of the second kind, the power must necessarily be less than the weight, since it must be further from the fulcrum; and in a lever of the third kind it must be greater than the weight, because it is nearer to the fulcrum. In a lever of the first kind, the power and weight act in the same direction with respect to the earth, both acting downwards, while in the second and third kinds they act in opposite directions. In a lever of the third kind there is what is called a mechanical disadvantage, the power being greater than the weight, and therefore this species of lever is never used except in cases in which velocity and not power is wanted, bearing in mind what I have just stated, that the velocity of the power and weight are as their distances from the prop.

If the centre of gravity of the bar itself be not over the prop, the preponderating weight of the bar must be taken into account. If the arms of the lever be not straight but curved, the effective lengths are perpendiculars drawn from the props upon the directions of the power and weight. If the lines of direction of the power and weight be not parallel, the effective lengths are the perpendiculars drawn from the prop upon the direction of the strings or ropes, which act upon the lever, and which are drawn by the power or weight. If several weights act upon different sides of the prop, or in different directions on the same side, the sum of those which tend to move the machine in one direction is equal to the sum of those which tend to turn it round in the other direction.

Of levers of the first kind there are numerous instances. Scissors, pincers, snuffers, and all similar instruments consist of two levers, of which the rivet by which they are united is the common fulcrum. A handspike or crowbar used to raise stones and for other purposes is a lever of the first kind. A poker used for raising the coals in the grate is also an instance, the bars of the grate being the fulcrum.

Instances of the use of levers of the second kind are not so frequent; yet we can mention a few. The power or advantage gained by this lever, is as great as the distance of the hand or power from the prop exceeds the distance of the weight from it; thus if the power or hand be seven times as far from the fulcrum as the point on which the weight is hung, a power equal to $\frac{1}{7}$ of the weight will support it. The oar of a boat is a lever of this kind. In this case the water against which the blade presses is the fulcrum, the boat is the weight, and the hand of the rower is the power. The rudder is another instance of the same kind; a door turning on its hinges or the lid of a desk are also examples, the hinges being the fulcrum and the weight being that of the door itself, acting at the centre of gravity. A chipping knife is another example. This instrument is fixed at one end, which is the fulcrum, the substance to be cut is placed under it, and the power is applied at the other extremity.

Levers of the third kind having a mechanical disadvantage are the least common. Machines of this kind may be considered as levers of the second order reversed, for the power must exceed the weight as much as the distance of the latter from the fulcrum exceeds that of the power from the fulcrum. They are used only in cases in which dispatch is more an object than the exertion of great force. The most striking use of levers of this kind is in the structure of the limbs of animals, in which the bones are so connected as to form levers of the third order.

A bar supporting a weight by two props is subject to the principles of the lever. The pressure on each prop is a certain fractional part of the weight namely, that fraction whose numerator is the distance of the weight from the other prop, and whose denominator is the distance between the props. It follows from this that the sum of the pressures is equal to the weights, and that the weight is distributed between the props in the inverse proportion of its distances from them. This is also true, whether the beam be horizontal or inclined.

When two men bear a weight on poles, the proportion sustained by each is to be determined on these principles. When it is placed on the centre between them, each bearer carries half the load. If the centre of gravity of the load be in the plane of the poles which support it, this equal distribution of the load continues, whether the bearers move on a level plane or on a declivity. If however the centre of gravity be above or below the pole, the load is not equally distributed if the bearers are ascending or descending. Thus, let G

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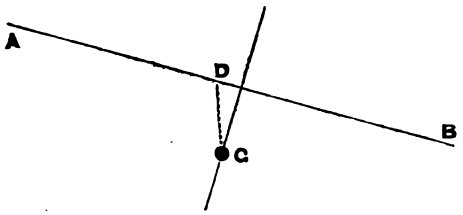
Fig. 31.

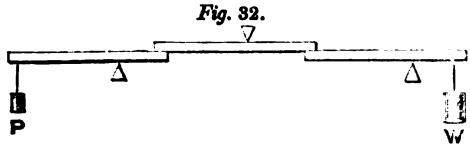


be the centre of gravity below the poles A B, and through G draw the vertical line G D. Since the weight acts as if it were collected at the centre of gravity, it must produce the same effect as if it were suspended from D, and therefore is distributed between the bearers A and B in the proportion of B D to A D, and consequently it presses more severely upon the upper bearer B; but if on the other hand the centre of gravity be above the bearer, the case is reversed.

This may be proved experimentally by providing two straight bars, and attaching them to the sides of a block of wood at right angles to its longest side. This block is pierced by three holes, in any of which may be placed a cylindrical piece of lead. Let the apparatus be so adjusted that when the lead is put into the hole between the bars, the centre of gravity will be between them, and that the centre of gravity will be below or above them, according as it is put into the hole below or above the bars. Let the apparatus with the lead in the hole between the bars be supported in the horizontal position and balanced by the weights. Now it will be found that the same equal weights will support the apparatus when it is inclined to the horizon, provided the strings by which it is suspended continue parallel. Then let the weight be removed to the upper hole; the same weights will support the apparatus in the horizontal position, but if it be inclined it will be necessary to increase the weight which supports the lower end, or diminish that which supports the upper end. The contrary will take place if the lead be placed in the lower hole.

We have now to say a word or two in respect to compound levers. The power may act on the weight through a series of levers, in which case the apparatus is called a composition of levers or a compound lever. The system of levers represented in the figure consists of three of the first

Fig. 32.



kind. Now let us suppose that the long arms are 12 inches respectively, and that the short arms are 3 inches; it will be found that a power of two ounces at P will sustain a weight of 128 ounces at W. In this case we have the product 2 × 12 × 12 × 12 = 3456 and the product 128 × 3 × 3 × 3 also equal to 3456, and the same would be found to be true of any power and weight which could balance each other.

A rectangular lever is a form not unfrequently used, and is governed by the same conditions of equilibrium as the other levers. Instances of it occur in the common bell pulls, in the trigger of a musket, in a claw hammer for drawing nails, and so on. In the hammer lever, if the shaft or handle be five times as long as the iron part which draws the nail, the lower part resting upon the board as a fulcrum, then by pulling backwards the end of the shaft, a man will draw a nail with one-fifth of the power that he must use to pull it out with pincers, in which case the nail would move as fast as his hand, but with the hammer his hand moves five times as quick as the nail. In them and all the other cases, the axis or fulcrum is considered to pass through the centre of gravity of the lever, and therefore the effect of the weight of the bar itself is not attended to. The conditions of equilibrium of the bent lever may be verified by experiment in a manner similar to the other cases, by suspending such weights as will produce equilibrium, and multiplying them by the lengths of the arms by which they respectively act. It may also form part of a compound system, but the general conditions of equilibrium established before will still be applicable.

Levers are also used for the purpose of magnifying motions so minute as not to be otherwise perceptible. This is accomplished by means of a lever of unequal arms, the power acting on the shorter arm, the longer arm showing the movement of the shorter by traversing a larger scale, as for instance in the dynamometer, the pyrometer, hygrometer, and wheel barometer.

A beautiful illustration of the application of this arrangement for reducing the amount of motion, is afforded by Mr. Peters' machine for microscopic writing; a long lever is suspended from a point near its upper end, which is connected with the longer extremity of another lever similarly suspended above it. A turned diamond point is affixed to the short end of this upper lever, and by means of a system of levers and pullies actuated by a cord from the bottom, is made to bear upon the surface of a piece of glass. A pen or pencil fastened to the lower end of the first lever is then taken in the hand, and written with on a sheet of paper or slate placed below. This writing is faithfully transferred to the slip of glass above, but diminished to such an extent as to require a high magnifying power to read it. In this way the Lord's prayer has been written distinctly in a circle but the three-hundredth part of an inch in diameter.

The weighing machine is formed of a combination of levers. This machine is commonly used at turnpikes for weighing waggons to ascertain that they are not loaded beyond what is allowed by law to the breadth of their wheels. A system of levers is placed in a horizontal position in a box about a foot deep, so that a platform supported by the levers shall be on a level with the road, the waggon to be weighed being rolled upon the platform, the power, which through the intervention of the combination of levers, is capable of sustaining it becomes an indication of its weight. The advantage of this is, that a very small weight becomes the measure of a very large one, and the practical process of weighing is thereby expedited.

Another kind of lever is that known as the knee lever (*fig.* 33.) It consists of a rod having a fixed point of support around which it moves. It is connected in the middle by a hinge with another rod, which when the power acting in the direction of the

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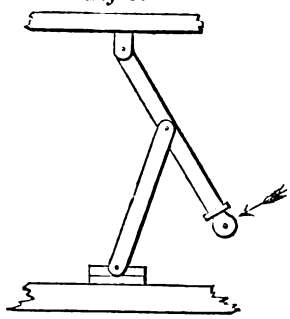
row presses on the free end of the lever, the end of the lower lever is driven forwards. If a force

Fig. 33.



of 50 lbs. act at A, then M would be pressed on at an angle of 60° with a force of 200 lbs., at 70° of 300 lbs., at 78° of 500 lbs., and at 84° of 1000 lbs.

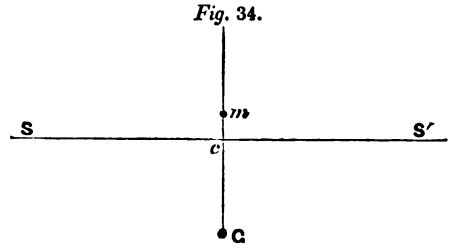
The mechanical efficiency of a machine depends on the ratio of the weight to the power, and is said to be greater or less according as this ratio is greater or less. It is in fact the product of the division of the weight by the power. Thus if the weight be ten times the power, the mechanical efficacy is ten. If this quantity be a fraction, the mechanical efficacy becomes a mechanical disadvantage. The same lever admits of having its mechanical efficiency raised at pleasure by changing the position of the power and weight with respect to the prop. This is a property in which it is distinguished from most other simple machines.

The Balance.—The balance is an instrument used for determining the weights of bodies, by shewing their relation to the weights of some other bodies, which are known or which are assumed as general standards of weight. This is one of the most interesting and generally useful applications of the lever, and assumes various forms according to the nature and magnitude of the substances whose weights are to be determined, and to the degree of accuracy which is required in the result. The most usual form of the lever balance is that of a lever of the first kind with equal arms, so that the substance to be weighed being suspended from one arm, and the weights assumed as standards being suspended from the other, the equilibrium will necessarily be established when these weights are equal. This, however, is only the general principle of the common balance. In its construction there are various circumstances to be alluded to which are of considerable importance.

The lever which forms the balance, and which is called the beam, should be so constructed that its centre of gravity should be immediately under the axis or centre of motion. If the centre of gravity were itself the centre of motion, it would remain stationary in any position, whereas the equality of the weights is determined by its assuming the horizontal position. If the centre of gravity were above the centre of motion, the least disturbance would cause the beam to upset; in fact, the fixing this centre of motion is of the utmost importance, for upon this depends the ease with which the balance would be affected by a small weight, and readiness with which it will return to a horizontal position. Great care is therefore taken in all balances that the axis of motion be placed a little higher than the centre of gravity, and in order to determine the best relative position of these points, an adjustment is sometimes added to raise or lower the centre of gravity.

The centre of gravity being by the construction of the beam beneath the centre of motion, will, when the beam is unloaded, always settle itself so as to be in a vertical direction. The substance to be weighed, and the weights with which it is to be compared, are placed in dishes suspended from points at the extremity of the beam, called the points of suspension. These points should be so placed that a straight line joining them should be perpendicular to the straight line which is drawn joining the centres of gravity and motion, and so that it shall be divided by that line into two equal

Fig. 34.



parts, that is, if S and S′ (*fig.* 34) be the points of suspension, M the centre of motion, and G the centre of gravity of the beam, the lines S S′ and M G should intersect at C, at right angles, and S C would be equal to S′ C.

In using the balance, in order to exhibit the direction of the line M G, a needle or index is attached to the beam, which sometimes plays upon a graduated arc, and when it is directed to that point of the arc which is in a vertical line passing through the centre of motion, the line S S′ will be horizontal, and the line M G, which is the direction of the index, will be vertical. These points may be practically determined as follows. In order to determine whether S S′ is perpendicular to M G, let the beam be suspended against a vertical plane, and mark the points on the plane at which the extremities S and S′ stand, then lift the beam off its centre and reverse it; if it be found that S equally takes the place of S′, then the line S S′ is horizontal and at right angles to M G, but otherwise not.

The common commercial balance is usually sustained upon a loop of metal on which the beam rests by a knife edge. In this case, when the balance is unloaded, the index ought to settle exactly between the sides of the loop, and it should always be in this position when equal weights are in the dishes.

The sensibility of a balance is measured by the smallness of the difference of weight which turns the index from its unloaded position or position of rest, and by the greatness of such deviation. The laws which are found to govern the sensibility of a balance are as follows:—

1. The sensibility of a balance is increased by increasing the length of its arms.

2. By diminishing the distance between the centres of gravity and motion.

3. By diminishing the weight of the beam.

4. By diminishing the distance between the line joining the points of suspension and the centre of motion.

5. It is also greatest when the load is smallest.

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It would be tedious now to enter on the construction of balances which have had extreme accuracy in view. Descriptions of these instruments may be found in most treatises on mechanics. Kater describes one made by Troughton and one by Robinson, the latter being so sensitive as to move with the addition of one thousandth of a grain.

In the Philosophical Transactions for 1826 is a description of a balance, which with 250 lbs. in each scale showed a movement of the index amounting to $\frac{1}{250}$ of an inch on the addition of a single grain, or 1,750,000th part of the weight. In the International Exhibition, now about to close, are many beautiful specimens of balances of even greater delicacy than these. Some of them have their beams made of aluminium, a metal of much less weight for equal bulk than any other that can be employed.

There is a remarkable property of the balance yet to be alluded to, and known as Helsham's property of the balance, from the name of the philosopher who first marked and recorded it. If a man standing in one scale and counterpoised by a weight in the other, places his hand against any part of the beam and presses it upward, he will thereby destroy the equilibrium, and make the scale descend whereon he stands.

Common balances are frequently misconstructed for fraudulent purposes, by making the arm from which the substance to be weighed is suspended longer than that from which the counterpoise is hung, thereby giving the substance to be weighed a greater leverage, and enabling it to support a counterpoise proportionably greater than itself. An excess of half an inch in a beam arm to which grocery is hung, would cheat the purchaser of nearly an ounce in every pound. If our object be merely to detect the fraud, it will be sufficient to transpose the weights and substance weighed, the one into the dish of the other. If the balance be honestly constructed, the equilibrium will be undisturbed, but if it be fraudulent, the weight will preponderate, because after the transposition it will have the greater leverage. In order to ascertain the true weight of the substance, let the counterpoise which will produce equilibrium after transposition be found, the two counterpoises or weights multiplied together, and the square root of the product extracted, the result will be the true weight. If the substance to be purchased be bought in two quantities nominally equal, and be weighed in different dishes, the result will be that the buyer will always get more than the just quantity, in proportion as the balance is more fraudulent. Thus, suppose that the arms of the balance were in the proportion of 11 to 12, and that two pounds of any substance be weighed in the different dishes, the counterpoise in each case being just a pound; in the one case the buyer would receive $\frac{11}{12}$ of a pound and in the other $\frac{12}{11}$, so that in one portion he would receive $\frac{1}{12}$ less than a pound, and in the other $\frac{1}{11}$ more; so that $\frac{1}{11}$ being more than $\frac{1}{12}$ he will on the whole receive more than the just quantity by the 132nd part of a pound.

But the best way of ascertaining the true weight of a substance with a fraudulent balance, or indeed with any common balance, is to place the substance in one dish and accurately counterpoise it with fine sand in the other. Then take out the substance to be weighed, and replace it with the weights with which it is to be compared, and the equilibrium being produced by them, the true weight will thus be determined, independent of all imperfections of the instrument. Even a projecting rod or branch of a tree may thus be made to answer the purpose of a weighing beam, by attaching any substance to its extremity and observing minutely how far such substance bends it, and then notice what weights would bend it as much.

The Roman balance, or the common steel yard, consists of a beam or bar of iron resting upon knife edges or on a pivot, and having one arm much longer than the other; to the shorter arm is suspended the scale pan, while the counterpoise or weight slides on the longer arm. The instrument must first be brought into a state of equilibrium without the load; a weight of, say, one pound is then placed in the dish, and the weight upon the long arm is drawn out until an exact counterpoise is effected. A weight of two pounds is next placed in the dish, and the counterpoise drawn out till it exactly balances the weight. Having marked two divisions at the two positions of the counterpoise thus obtained, let the whole length of the arm be divided into divisions at the same distance, and the number of any division beginning with that which is nearest the fulcrum, will give the number of pounds which the counterpoise will sustain when placed at that division.

The Chinese, who are so remarkable for the simplicity to which they have reduced all their common implements, weigh any small object by a delicate pocket steel yard. It is a rod of wood or ivory about six inches long, with a silk cord fixed by passing it through a particular part to serve as a fulcrum, and with a sliding weight on the long arm together with a small scale attached to the short one.

The Danish balance is a steel yard, in which the counterpoise is fixed in one position, but the fulcrum is moveable. The divisions commence from a point near the weight where the loop is when the balance is unloaded. A determinate weight, say of one pound, is then affixed at the end for the substance to be weighed, and a mark is made at that point at which the loop is when this weight is counterpoised. A weight of two pounds is then used, and the balance again adjusted, and a mark being made, the beam is then divided into spaces equal to the distance between the first and second marks.

There is also the Bent Lever balance, which consists of a bent lever so constructed and arranged that as the weight increases the leverage of that end of the lever is diminished, while the leverage of the counterpoise is increased. This balance is graduated in the same manner as the other balances.

There is also a balance known as Brady's, very similar in principle to the last. It consists of an iron frame much heavier towards one side than on the other parts. It is supported upon a fulcrum, and there is a moveable suspender to which a scale or hook is attached to receive the substance to be weighed.

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There are three distinct positions in which this suspender may be placed, and for which there are three distinct graduated scales. When a weight is suspended from the hook, or placed in the dish, the machine is turned round the fulcrum and the scale descends until equilibrium is established and the amount of weight is read off from that scale which corresponds to the position of the suspender. One scale shows the weights of bodies not exceeding two pounds, and is graduated to ounces, another determines weights not exceeding eleven pounds, and is graduated to two ounces, and the third determines weights not exceeding thirty pounds and is graduated to four ounces.

The Wheel and Axle.—The next of the mechanical powers or elements of machinery which we have to consider is the Wheel and Axle.

When a very great force acting through a small space is required to be produced by a comparatively small power, the common lever, whether simple or compound, is a machine well adapted to produce the effect. But the defect of this machine is, that under all circumstances it works through a very limited space, and that the action of the power is almost necessarily intermitting. Thus if a weight is to be raised by a lever, the prop or fulcrum is placed somewhat above the point at which the working end of the lever is to be applied to the weight. The end to which the power is to be applied is therefore above the fulcrum. On depressing the extremity, the weight is raised until the end at which the power is applied is a little below and that which sustains the weight a little above the fulcrum. The weight must then be supported by some other means until the fulcrum is raised above it and another similar exertion of the power be made.

To remove this inconvenience a modification of the lever, called "The Axis in Peritrochio," or the axle in the wheel, is used. The power is applied at the circumference of the wheel, and generally in the direction of the tangent. A cord is wrapped about the cylinder, and is the means by which the weight is to be raised or resistance overcome. This machine is only a modification of the lever, and the condition of its equilibrium is that the power multiplied by the radius of the wheel is equal to the weight multiplied by the radius of the axle. Thus if the power be two pounds and the radius of the wheel 12 inches, and the weight 8lb. and the radius of the cylinder 3 inches, there will be equilibrium, each product being 24.

When the wheel is turned once round, as much rope must be drawn off as binds once about the wheel, or which extends through a space equal to the circumference of the wheel, but whilst the wheel is turning once round, the axis is also turned once round, and the rope by which the weight is suspended will bind once round the axis. The weight will therefore be raised through a space equal to as much rope as will go round the axle, that is, equal to its circumference. It therefore follows that the velocity of the power is to the velocity of the weight as the circumference of the wheel is to that of the axle.

This machine has been not improperly called the perpetual lever, because the motion which it communicates to the weight is constant and not intermitting, as in the case of the common lever.

In order that it may be possible to suspend the action of the power without suffering the weight to descend or recoil, and thus lose the advantage which has been gained by its elevation, a contrivance called a ratchet wheel is sometimes annexed to the cylinder or axle. This is a wheel furnished with teeth curved or bent in one direction which is that direction in which the rope is coiled round the cylinder. A catch working on a pivot falls by its weight between the teeth of the wheel, and the effect is that the wheel and cylinder are suffered to revolve in that direction in which the weight is raised, but are not permitted to revolve in the other direction, so that the weight can never descend unless the catch be prevented from acting on the ratchet wheel.

There are various ways in which the power is applied to the wheel, and the weight suspended by the rope is only to be understood as a general representation of the mechanical effect of the power, however it be applied. Sometimes pins or studs are placed at equal distances round the circumference of the wheel by which the hand may be applied as the power. An instance of this manner of applying the power will be seen in the wheel used to work the rudder of a ship. Sometimes there is no wheel, but a number of long levers are inserted in the axle and diverge from it like spokes from the box of a carriage wheel, and the operators move the axle by these levers. Instances may be seen in the capstans used on board vessels and also placed on wharves and piers for warping vessels in and out of harbour. Frequently, as in the windlass or horizontal axle, likewise used on board of vessels, there is not either a wheel or driving spokes, but simply holes in which the workman inserts the end of a strong bar of considerable length, by which he turns the axle and raises the weight. He removes the bar as he works from one hole to another, the weight being sustained by the action of the ratchet wheel in the interim. The windlass is also frequently wrought by a winch, as in the method used for drawing water from a well.

The axis is sometimes horizontal and sometimes vertical. In the windlass it is horizontal, also in most kinds of cranes. In the capstan it is vertical. The advantage of the latter position is very evident. The workmen insert levers into the holes made to receive them and walk round the axle pushing the levers before them. In this manner a great number of men may work together, and there need be no intermission of power even when different men succeed each other.

In estimating the effect of the resistance or weight when the rope by which it acts has any considerable thickness, half the thickness of the rope is to be considered as a part of the radius of the cylinder, as the force is considered to be transmitted through the centre or axis of the rope.

In the simple wheel and axle, whatever be its form or peculiarity, its mechanical efficacy depends on the ratio of the radius of the wheel to the radius of the axle. There are therefore only two ways in which this efficacy may be increased; by increasing the leverage of the power or diminishing the radius of the cylinder which supports the weight. Although there is no theoretical obstacle,

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there is practically a limit to the mechanical efficacy of this engine. Thus if on the one hand we attempt to increase this efficacy by giving to the power a considerable leverage, the machine will become unwieldy. And on the other hand if we attempt to increase the efficacy by diminishing the thickness of the axle, we diminish the strength of that part of the machine which must support the weight. In cases, therefore, where great resistances are to be overcome, it is a problem of considerable importance to assign a method by which, without rendering the machine more complex, sufficient strength may be preserved by maintaining the thickness of the axle, and the machine may not be rendered unwieldy by increasing very much the leverage of the power, and a high degree of power may be obtained. All these ends may be attained by the modification of the wheel and axle known as the Chinese axle, one end of which is larger than the other. The advantage of this engine is that its efficacy may be increased without any limit by merely diminishing the difference of the radii of the cylinder, without either increasing the leverage or diminishing its thickness. A great advantage attending this machine is that there is no recoil upon the remission of the power, and therefore that the use of the ratchet wheel and catch is superfluous.

The principle of varying the diameter of the cylinder while the leverage of the power remains unvaried, is sometimes used to accommodate an uniform power to a varying resistance or a varying power to an uniform resistance. This may be seen in the fusee of spring clocks or watches.

Complex Wheelwork.—It does not always happen that the end to be accomplished can be obtained with convenience by the common wheel and axle, and it frequently becomes necessary to transmit the effect of the power to the resistance through a system of wheels and axles mutually acting upon each other. As the wheel and axle is only a modification of the lever, so a system of such machines acting upon one another, is only another form of the compound lever, and the conditions of equilibrium are exactly the same in both. Each separate wheel and axle being a lever, the effect of such a combination as we have described is the same as that of a series of levers, whose longer arms are equal to the radii of the wheels, and whose shorter arms are equal to the radii of the axles.

In this case the wheels and axles are supposed to work by the friction of their surfaces. In light work when the pressure on the machinery is not very considerable, this method of connecting the wheelwork is often adopted with advantage. The friction of the wood is increased by cutting it so that the grain of the surfaces in contact shall run in opposite directions, also in other cases by glueing leather upon the surfaces of the wheels and axles. There is a saw mill at Southampton in which wheels working by friction have been used for nearly 20 years and have been found to work well.

A very common method of transmitting force is by endless ropes or straps passing round the circumference of the wheel and axle. In this case it is necessary that the driving wheel should not touch the driven wheel, and they are usually some distance apart. Motion is thus communicated through the various departments of a factory with comparative ease.

The most usual method of transmitting motion through a train of wheelwork, is by the formation of teeth upon their circumferences so that the tooth of the one falls into the indenture of the other, and thus the action is insured so long as the strain is not so great as to fracture the tooth. In order that these teeth shall work together with the least possible amount of friction, and also to ensure the uniformity of the motion communicated, it is necessary that they should be formed after a certain curve known as the epicycloidal. It is also necessary that they be perfectly true in their proportions. The number of teeth therefore may always be used to express the circumference of the wheels and the ratio of the numbers of the various wheels determines their respective velocities.

Thus a wheel of 60 teeth will cause an axle or pinion as it is called of 6 teeth to revolve ten times for every one of its own revolutions. This principle is carried to great extent in Horology, the most intricate calculations having to be made in order to obtain certain proportionate velocities necessary to represent certain celestial motions.

Familiar instances of the use of toothed wheelwork are so numerous that it is scarcely necessary to recapitulate them. For the increase of power the crane for lifting weights may be taken as an example, while for the production of motion only the watch or clock may be adduced as an instance.

NOTICE TO THE EXHIBITORS IN CLASS 15 OF THE INTERNATIONAL EXHIBITION 1862.

The Journal Committee are desirous of inserting in this Journal a general summary of the display of Horological Instruments at the International Exhibition. Such a summary it is thought will possess future as well as present interest. It would be next to impossible for any individual not thoroughly acquainted with the various branches of Horology, to undertake this on his own resources; and, for a person fitly qualified, the tendency to partiality on the one hand, and to depreciation on the other might reasonably be supposed so probable that his services could not be accepted. To ask a special committee to perform the work, would be nearly as ineffectual,—for are the Horologists even satisfied with the decisions and awards of the jurors, half of whom cannot be supposed to entertain any trade partialities whatever, seeing that their professions and positions in society place them above all suspicion? Well, then, under these circumstances it appeared difficult to see a way to the end in view. However, unwilling to let the Exhibition in which English Horologists have we believe acquitted themselves well, pass without any record of it in the pages of the Horological Journal,

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further consideration was given to the matter; and the conclusion arrived at was that each Exhibitor, English and Foreign, should be invited to send to the Editor a general description of the goods exhibited by him, pointing out what he deemed to be novel or excellent characteristics. Accordingly the following Circular was drawn up, printed, and great trouble was taken to furnish every Exhibitor in Class 15 with a copy. If there should be any one who has not received it, we hope that he will believe that the omission was quite unintentional.

BRITISH HOROLOGICAL INSTITUTE.

JOURNAL COMMITTEE.

35, Northampton Square, London, E.C.
October 6th, 1862.

SIR,

Will you kindly favour us with a general description of your Goods displayed in the Exhibition, and point out whatever you consider to be novel or excellent in them. It is intended to draw up such a summary of the Horological display as the readers of our Journal will doubtless expect. Please direct the same to

Your obedient Servant,
THE EDITOR.

This course it was concluded would lead to no partiality on the one hand, nor jealousy on the other. From the various replies it is intended to draw up a general summary, using the Exhibitor's own language as nearly as possible for the account given of his goods, in every instance. As each person must reasonably be supposed to know the novelties and excellencies of his articles *as well* as any one else, and of course, could *better* give an exact statement of what he has exhibited, we do not imagine that any exceptions can be taken to our proceeding. The proverb "self praise is no recommendation," is known to most languages, and we believe that generally more merit will not be claimed than can be fairly deserved. We therefore anticipate that the Exhibitors will appreciate our object, and at a little trouble to themselves enable us to carry it out to their satisfaction. On behalf of the Journal Committee. THE EDITOR.

ON THE BEST MEANS OF STIMULATING IMPROVEMENT IN PRACTICAL HOROLOGY.

To the Editor of the HOROLOGICAL JOURNAL.

Sir,—Statistics, both British and foreign, have abundantly proved that the development of special industries follows a progressively increasing ratio, especially in such industries as involve the demand for great ingenuity. But as the amount of talent, measured by any standard, may be averaged for any given number of individuals, and therefore the total amount for any larger number may be represented approximately by like proportions. Some additional cause must operate to produce the continual increase beyond this proportion observable in such special manufactures; striking instances of this fact are presented by the Textile Arts, Gun-making, Lock-making, Engine-making, &c. The tracing of this effect backward up to its cause may possibly enable us to apply the said cause, or some substitute for it, to stimulate the end desired.

Firstly, then, it is very observable that inventions in any given direction are few and far between, until invention has given rise to manufacture, and manufacture has called on many to devote their whole time to the production of certain results.

Secondly, it will be noticed that the progress made is rapid in proportion to the absence of other engrossing occupations for the population of a district where any manufacture is carried on.

Thirdly, the improvement in processes and modes of manipulation is great in proportion to the number of skilled operatives collected in any given place, and small in proportion to the largeness of the space over which they are scattered.

To my mind, all these facts are reducible to one proximate cause: that cause being the effect produced on other minds by intercourse with men devoted to similar pursuits, and to the highly suggestive nature of the conversation of those whose daily occupation stimulates thought aided by the sight of machines and tools, which familiarize the mind to those mechanical combinations that enable men to shape their designs to the powers of mechanics to execute.

Applying this reasoning to the Watch Manufacture it will be found, that in England the chief defect is in the processes. The manner of producing the various parts of machines remaining without improvement, as might well have been expected where the production of the sundry parts of a delicate machine affords occupation for as many garrets, and where want of communication between man and man precludes those suggestions for the improvement of tools and modes of manipulation, that would certainly follow the aggregation of mechanics in this as it has done in other arts.

In the absence of a factory system, in which contrivances might have been suggested for the bringing about of better results, the

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British Horological Institute might operate upon the minds of men, and develope their ingenuity through the love both of gain and of honour by the offering of prizes.

This was attempted some time since by the Council, when one of its members offered a reward for the best improvement in the watch movement, but without any results. This might have been anticipated, for two reasons; one reason being that no competitor would come forward with an improvement so small as not to be deemed worthy of a public reward. The other reason being, that an improved form, important enough to claim a public reward, would repay the contriver better to patent and monopolize for a time than to publish for a medal.

But the application of the principle to tools, machines, and processes might have a different result, especially if opportunity for meeting were conceded by the Council to those who would be likely to compete.

I propose therefore that money, or other prizes, be offered for improvements in the modes of producing the various parts of Horological machines; and especially for means of producing any part by machinery, the same never having been hitherto made except by hand. I further propose that two or more persons may be allowed to unite for the purpose of devising means of winning these prizes and to claim the said prize, as a committee to decide amongst themselves.

I further propose that the various established manufacturers be solicited to subscribe money for this purpose with the privilege of nameing any particular part or process after consultation with the Council of the Institute. The particular prize being coupled with the particular manufacturer's name; and a permanent record being kept of the same by the Institute.

I believe some success would be found to attend this mode of action, because even partial success might be worthy of some reward, if not of the whole; and secondly because many a working man is deterred from making experimental tools by the expense, but if there were something to be gained beyond the doubtful advantage of its application to his own speciality he would proceed on the chance of repayment so offered.

I send this proposition to the Journal for the purpose of eliciting the opinion of the Trade generally, before proposing the scheme to the Council of the Institute, so that the embodiment of any good suggestions may conduce to its general acceptance.

Finally, whenever the proposition may be carried out, I shall be happy to subscribe and to do all in my power to make it practicable.

E. D. Johnson.

THE ANEROID.

Since the article on the Aneroid in our third volume was written, the London manufacturers of the instrument have succeeded in reducing its size considerably. It may now be bought of the opticians, not larger than an inch and a half in diameter, and about three quarters of an inch in thickness. We have seen it mounted in watch cases, and adapted for the waistcoat pocket. By a beautifully simple contrivance, a milled rim is adjusted to move round with hand pressure, and carry a fine index or pointer, outside and around the scale engraved on the dial, or face, for the purpose of marking the reading; so that the subsequent increase or decrease of pressure may be readily seen. A similar application to a watch would enable the wearer to measure intervals of time without trusting to memory.

From the experience of some friends who have given these small aneroids a trial, it appears that they are quite portable, little influenced by temperature, and equally as accurate as those of the largest size. Besides serving the purpose of a weather-glass in the house or on a journey, they are suitable for the measurement of heights not exceeding 7000 feet. A friend, who ascended Helvellyn this summer, had a small aneroid with him, and made the following observations.

August 12th, 1862, 10 a.m. at the ordnance "Bench Mark" on the first milestone from Ambleside, (found by survey to be 188 feet above the sea), the aneroid read 29·89 inches; and about 1 p.m. at the summit of Helvellyn, 26·81; near 5 p.m. at the milestone again, 29·76. The temperature of the lower air was 57° of the upper 54°. From these observations the height of the mountain is deduced by Mr. Simmonds's "Meteorological Tables" as follows.

	Inches.		
Reading at 10 A.M.	29·89		
,, 5 P.M.	29·76		
Mean ,,	29·825	Table VI.,	88709
Upper reading ,,	26·81	,,	85925
			2784
Table VII.	2784 × ·0522	=	145·3
			2929·3
Table VIII.	. . .		2·7
			2926·6
Table IX.	. . .		7·9
			2934·5

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Brought forward	2934·5
Height of lower station . .	188·0
,, Helvellyn .	3122·5
In Sir J. Herschell's Physical Geography it is given as	3115 ft.

So near an agreement must be attributed to the excellence of the aneroid as much as to the careful accuracy of the observer.

S.

ELECTRICITY OF THE ATMOSPHERE.

The researches of philosophers have ascertained that electricity is intimately connected with almost all atmospheric phenomena. Lightning and thunder are clearly known to be caused by the agency of electricity displayed on a vast scale; and auroræ, fireballs, St. Elmo's lights, waterspouts, whirlwinds, and even earthquakes have been attributed to electrical disturbance, occasioned by the natural operations of the material world. But our knowledge of atmospheric electricity cannot be deemed even approximately perfect. Much of it consists of conjecture; while its evident connection with the ordinary conditions of the atmosphere, as regards pressure, temperature, humidity, has not been thought worthy of the study which must eventually be given to it. Nevertheless, what has been discovered regarding the operations of this mysterious natural agent, in the ocean of air at the bottom of which all animated nature lives, is highly curious and interesting, and of much importance to mankind. We propose to take a rapid glance at this department of electrical science, to trace its rise and progress; to explain the general electrical condition of the atmosphere, and finally to consider the agency of electricity in the thunderstorm.

It was not until the commencement of the eighteenth century that the science of electricity made any progress, although its origin is attributed to the property of amber, which enables it to attract and repel light substances after it has been rubbed, and which property was known to the nations of Europe since the days of Thales, a distinguished philosopher of ancient Greece. Then experimentalists and philosophers were led to conclude that electricity was a latent agency pervading all matter, and active in all the operations and phenomena of nature. Even the first experimentalists in electricity, as for instance Wall and Grey, felt convinced from the light of the spark, together with the cracking noise attending electrical excitation that lightning and thunder were analogous phenomena. Nollet, a French abbè, wrote in 1745, that he believed that there was great probability of a thunder cloud being an electrified body, similarly charged to conductors, or receivers of frictional electricity, used in experiments. These were conjectures hazarded before the invention of the Leyden jar, and the important discovery of electrical induction. This instrument, which exhibits, when discharged, in so striking a manner the intensity of the light, the strength and snap of the spark, and the power of the shock from frictional electricity, could hardly have failed to have directed the attention of observers to the evident resemblance to the atmospheric phenomena of the thunderstorm. Afterwards, when the idea occurred of uniting several jars, thus forming what has been termed an electric battery, and apparently proving that no limit could be fixed to the stupendous effects of this agent, it was scarcely possible to doubt the identity of lightning and electricity, for it was seen that the latter exhibited in miniature all the properties of the former. Hence that invention, by furnishing a means of accumulating a great amount of electricity (if we may speak of it as a substance) gave also the ability to intensify and increase the effects and phenomena attending the ordinary experiments with electricity, and tended to turn former conjectures into certainties, so that the opinion became general that lightning in the operations of nature was identical with electricity as developed by man.

No one, however, pretended to be able to offer a substantial reason for, much less to give a satisfactory proof of the truth of this belief, until Benjamin Franklin, a man whom we all know to be honoured in history as well as in philosophy, but then a person very little publicly known, happily devised a means of satisfying both reason and belief. It has been well said of him "Eripuit fulmen cœlo," he snatched the lightning from the sky.

In the year 1749, Franklin wrote to a friend to this effect. "If a gun-barrel electrified will give a spark at an inch distance with a loud snap, to what a great distance may ten thousand acres of electrified clouds strike, and how loud must be that crack?" and he cited the analogies perceived between lightning aud electricity. Lightning is generally zig-zag, and not continuously straight; it strikes the most prominent bodies, takes the readiest conductors, sets fire to inflammable matter, rends bodies in pieces, destroys animal life, affects the mag-

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netic needle; and, although on a miniature scale, amberism or frictional electricity, acts similarly. Having had his attention drawn to the effects of points on free electricity, by a friend who had electrified an iron ball with a needle stuck in it, expecting to obtain a stronger spark from the needle-point as from a focus, but had found the discharge therefrom quite feeble and peculiar, Franklin performed similar experiments and found that the ball could not be effectually electrified with the needle protruding; and also, that if a pointed conductor, connected with the earth were presented to the electrified ball, its electricity was gradually and silently withdrawn. His researches led him to conclude that if electricity were present in the atmosphere, it could be drawn therefrom by means of proper conductors. Acting on this thought he sought and obtained permission to erect a pointed metallic conductor on a high spire then in course of construction in Philadelphia, to extend from the ground to the top of the building. Meanwhile waiting the completion of the spire, he made known his conclusions and arrangements, and the investigation was immediately taken up in France by M. Dalibard, who erected a similar apparatus at Marley la Ville, near Paris. By this conductor Dalibard obtained electricity from the atmosphere, in May 1752, on the occasion of a thunder storm. Thus, while the merit of having invented and described the apparatus to be employed is undoubtedly due entirely to Franklin, he did not have the fortune of witnessing the first demonstration of the identity of lightning and electricity. Ignorant of this discovery in France, and before the completion of the spire, it occurred to Franklin that a kite would afford a ready means for conducting electricity to the earth, if it were present in a free state in the atmosphere. Accordingly, in June 1752, in company with his son, he sent up a kite, made by stretching a silk handkerchief on two crossed sticks. The lower end of the string was attached to a key, and to the other end of the key a length of ribbon by which the kite was made fast to a post when sufficiently elevated. Upon the passage of a dense cloud the fibres of the hempen string bristled up, and Franklin felt that his conjectures had resulted in a most remarkable discovery. A shower of rain soon after falling wetted the string, making it a better conductor, while the non-conducting silk was kept carefully dry by the protection of a shed. Sparks were now obtained from the key in great abundance, and it became evident that they might prove dangerous. On subsequent occasions Franklin succeeded in charging Leyden jars with atmospheric electricity, with which he performed the ordinary electrical experiments, and even charged his jars to a tension sufficient to kill a turkey and other small animals.

To Romas, in France, the idea also occurred of exploring the air with a kite, and his experiments were not unattended with danger. Flashes of fire a foot long accompanied with a loud noise were obtained from his conductor, while the kite itself appeared in a luminous frame.

The necessity of great precaution became therefore evident from these experiments; nevertheless Professor Richman, of St. Petersburgh, lost his life, in the following year, from want of caution. He had erected an insulated metallic rod, at the top of his house, communicating with a large quadrant electrometer in a room. On the occasion of a thunderstorm he went to examine the indicator, showing the intensity of the electricity communicated to the apparatus, and advancing too near, a flash of lightning passed from the conductor to his head, killing him instantly, rendering his assistant insensible, carrying a door off its hinges, and doing other destruction.

These experiments fully and undoubtedly established the identity of lightning with electricity; and exploring kites and conducting apparatus in the hands of succeeding philosophers have abundantly demonstrated that electricity plays an important part in all atmospheric changes and phenomena; although much mystery still surrounds the subject, and we are unable to explain the mode in which the influence of electricity is exerted upon the gases and vapour of the atmosphere.

(To be Continued.)

A PROBLEM.

*** *The best Solution received from our readers, will be inserted in our next.*

If at Plymouth, in longitude 4° 7′ 20″ W, on October the 23rd, 1861, at about 8h.30m. a.m., a chronometer be 15m. 36s. fast for mean time at place; and on November 3rd, off Gibraltar, Europa Point, in latitude 36° 6′ 40″ N, longitude 5° 21′ 45″ W, bearing WNW, distant 12 miles, the same chronometer be 17m. 53s. fast for mean time at place, at about 3h. 45m. p.m.; determine its error for Greenwich mean time, at noon 3rd, and its daily rate.

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METEOROLOGICAL OBSERVATIONS, Taken at 9 A.M., SEPTEMBER, 1862.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	30·060	58	55	66·5	49	NNE	2	cb	r, cb
2	29·794	59·5	57	63	56	NNW	2	c	cb, b, r
3	29·653	56	50	66	51	SW	6	b	bc
4	29·820	55·7	53	62	49	W	2	c	cb
5	29·830	56	54·5	62	50	NNW	1	bc	bc
6	29·952	57·5	55	62	55	SW	2	m	bc
7	30·030	60	58	66	58	W	4	cb	cb
8	30·146	61·5	59	66	58	SW	3	o	o, cm
9	30·122	62	59·5	68	59	W	2	bc	bc, rr
10	29·964	57·5	55·5	67	50	NNE	3	or	o,bc,m
11	30·145	52	49	62·5	46	WSW	2	b	b
12	30·203	54	51·5	61	47	W	2	bm	bc
13	30·025	60	57·5	66	57	SW	3	cb	cb
14	29·800	61	59	67	59	S	3	o	r, bc
15	29·994	61	58	63	58	E	2	b	b, o
16	30·229	60·5	57·5	67	57·5	NNE	4	o	c, b, o
17	30·379	58	55·5	66	53	NNE	5	o	cb
18	30·442	57	54	63	50	NNE	3	cb	cb, b
19	30·395	60·5	58	64	56	NE	5	b	b
20	30·295	60	57·5	67·	54·5	ENE	5	b	b
21	30·265	58	57	67	55	NE	4	om	o
22	30·302	58	54·5	62	54	NE	4	o	o, bc
23	30·131	58	54·5	61	50	ESE	3	o	c, b
24	29·978	58	56	63	50	SSE	2	o	cor
25	29·887	59	58	64	58	W	1	r	c, b
26	29·940	60 5	58·5	64	55	S	2	cb	cr,bc,r
27	29·941	60	59	66	58	Calm	0	cm	r, mc
28	29·955	60	59	64	58	Calm	0	m	rr, mr
29	29·850	63	62	65	59	SE	2	mr	rr
30	29·853	63	60	64	56	SSW	5	cb	cb, r, b
	30·046	58·8	56·4	64·5	54·2		2·8	Mean.	

REMARKS.

The greatest atmospheric pressure noted was 30·447, at 10 a.m., 18th; and the least 29·653, at 9 a.m., 3d; so that the greatest range was 0·794 inch.

Between the 4th and 6th, the wind veered from W through N, E, and S to W, and was light.

Rain fell on 12 days, during about 55 hours, and 1·70 inches was measured.

Referring the 9 a.m. wind observations to the cardinal points, it will be found to have come from the N on 7 days; E, 6; S, 7; W, 8; while a calm occurred twice.

NEW BOOKS.

Newly published Pamphlets or Books relating to Horology, and also to mechanical or physical science generally, will be noticed in the Horological Journal, if a copy is sent to the Editor at the Institute, 35, Northampton Square, E.C. The copy to be deposited in the Library of the Institute. The Journal is managed by a Committee of the Council, and nothing is inserted without their sanction. There is, consequently, sufficient guarantee that all such notices will be characterised by a spirit of fairness, without any partiality whatever.

EQUATION OF TIME TABLE

FOR NOVEMBER, 1862.

Day of the Week.	Day of Month	At APPARENT NOON. Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *added* to Mean Time
		m. s.	s.	m. s.
Sat...	1	16 15·71	0·041	16 15·72
Sun...	2	16 16·70	0·008	16 16·70
Mon..	3	16 16·90	0·025	16 16·90
Tues..	4	16 16·30	0·059	16 16·29
Wed..	5	16 14·89	0·093	16 14·87
Thurs.	6	16 12·65	0·128	16 12·62
Fri...	7	16 9·58	0·163	16 9·54
Sat....	8	16 5·67	0·198	16 5·63
Sun...	9	16 0·92	0·234	16 0·86
Mon..	10	15 55·31	0·270	15 55·25
Tues..	11	15 48·83	0·306	15 48·75
Wed..	12	15 41·49	0·342	15 41·40
Thurs.	13	15 33·29	0·378	15 33·19
Fri...	14	15 24·21	0·414	15 24·10
Sat....	15	15 14·27	0·450	15 14·15
Sun...	16	15 3·47	0·486	15 3·35
Mon..	17	14 51·81	0·522	14 51·68
Tues..	18	14 39·29	0·557	14 39·16
Wed..	19	14 25·93	0·591	14 25·79
Thurs.	20	14 11·74	0·625	14 11·60
Fri...	21	13 56·74	0·658	13 56·59
Sat...	22	13 40·94	0·691	13 40·78
Sun...	23	13 24·35	0·724	13 24·19
Mon..	24	13 6·98	0·755	13 6·82
Tues..	25	12 48·86	0·786	12 48·69
Wed..	26	12 30·00	0·816	12 29·83
Thurs.	27	12 10·42	0·845	12 10·24
Fri...	28	11 50·14	0·873	11 49·97
Sat...	29	11 29·18	0·901	11 29·01
Sun...	30	11 7·56	0·928	11 7·40

TO CORRESPONDENTS, &c.

All Communications for this Journal should be addressed to the EDITOR, *at the Office*, 35, Northampton Square, Clerkenwell.

The Journal is always open to Members, who are invited to communicate letters, extracts, or papers, relating to applied Science, but preference will always be given to matters relating intimately or remotely to Horology.

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MECHANICS.

Tenth and Concluding Lecture delivered to the British Horological Institute.

By W. Hislop, Esq., F.R.A.S., Hon. Sec.

(*Continued from page* 30.)

The Pulley, Inclined Plane, Wedge and Screw.

We will first call attention to the groups into which, as we stated in our last lecture, the mechanical powers may be said to divide themselves; namely, 1st, the Lever (with the wheel and axle); 2nd, the Pulley; and 3rd, the Inclined Plane (with the wedge and screw). On that occasion we treated of the Lever with the wheel and axle, and in this our concluding lecture on the Elements of Machinery, and also of our course on Mechanics, we propose to consider the other two groups; namely, the Pulley and the Inclined Plane with the Wedge and Screw.

There are many points in which the pulley partakes of the principles of the lever, and, in fact, the power and properties of the simple pulley may be explained by referring to those principles. We may thus see that the mechanical powers or elements of machinery are divisible into two great sections, the one possessing a centre of motion, as is the case with the lever, wheel and axle, and pulley; and the other division having no centre of motion, as the inclined plane and wedge.

To proceed however with the original division of our subject. The kinds of pulley, (using the term in its generic sense) are very numerous; but they all consist of combinations of a grooved wheel, moveable on an axis, and a rope lying in the groove, to which the weight and power are attached. The manner in which this rope passes under and over in a system of these wheels, so as to connect the force with the resistance, or the power with the weight, determines the species or kinds of pulley.

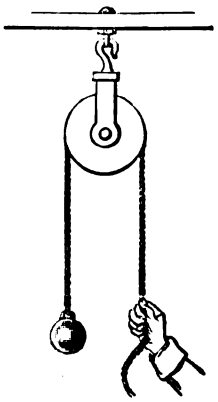
But, whatever the mechanical arrangement of the wheels and of the rope, the object of all pulleys is the same; namely, the transmission of the tension of a rope without sensible diminution, so as to obviate the loss of force consequent on rigidity. If a rope possessed perfect flexibility, any system of fixed points, as a series of nails, for instance, over which the rope might be bent, would answer the same end mechanically as a system of pulleys; but we know that if a rope be bent over a sharp edge, little force will be transmitted beyond that point.

The pulley, then, is a wheel, called a sheave, made of brass, iron, or wood, turning on an axis, and enclosed in a kind of frame or case, called a block, which admits of a rope to pass freely over the circumference of the pulley, which is usually grooved, to prevent the rope from slipping off. The pulley is said to be fixed or moveable, according as its block is fixed or rises and falls with the weight. An assemblage of several pulleys is called a system of pulleys.

This machine possesses many very important advantages, such, for example, as that it is comparatively of small weight and readily transferable from place to place, it can be made to act in any required direction, and is in many cases applicable, when we should find it difficult to apply any other mechanical power. Its disadvantages however are considerable, arising principally from the friction, which is sometimes very great, and also from the rigidity of the ropes with which the pulleys are necessarily connected.

I have said that a pulley is either fixed or moveable. Fixed pulleys are only useful for altering the direction of the motion to any convenient position, no advantage being gained by

Fig. 35.



them in respect of power. For instance, we have here a fixed pulley, and we observe that a weight of four ounces requires an equal weight to balance it. The one weight also moves with the same velocity as the other, for if I cause one to descend a foot the other ascends precisely the same distance in the same time. Although there is no mechanical advantage gained by the fixed pulley, yet it is a contrivance of very great use, as it enables us to give the motive power the most advantageous direction for its exertion.

Thus in elevating a weight to the top of a building, we may transmit the traction of a horse moving along the ground, by means of fixed pulleys, to the weight to be raised. In the same manner sails are spread and flags hoisted on the yards and masts of a ship, by sailors pulling a rope upon the deck. It is possible, by means of fixed pulleys, to lead off the weight of a clock to any convenient position either in the case, or if it be a turret clock, in any part of the building. It often happens that there is not sufficient depth below the

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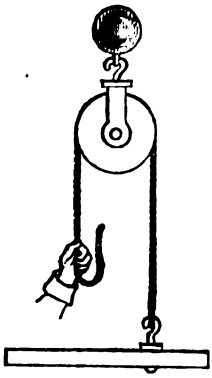
movement to enable the weight to act long enough, while there is room above. The rope is then led upwards and passed over a fixed pulley above, so as to take advantage of the utmost space available.

It is the moveable pulley, however, which is the real mechanical power or accumulator of force, and it is important to bear this in mind in the inspection of machinery in which pulleys are used. However numerous the fixed pulleys may be, they only alter the direction of the force impressed, while the efficacy of the machine will be in proportion to the number of moveable pulleys.

The single moveable pulley always has the weight to be moved connected with its centre, and may or may not be combined with a fixed one. In the first case the direction of the power is upwards as in *fig.* 35. In the latter case it is as in *fig.* 36. This will serve to explain at once the principles on which the efficacy of the

Fig. 36.

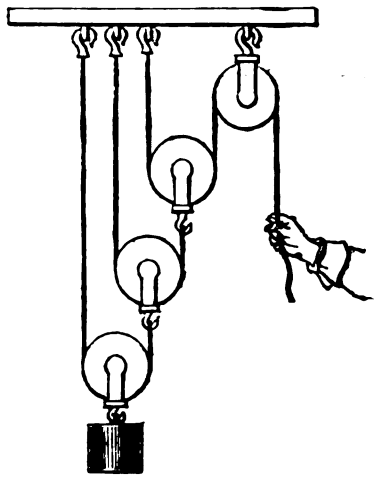


pulley depends. We observe here that we have a weight equal to eight ounces suspended from the centre of the pulley. Around the sheave a cord is passed which returns upwards. It follows, then, that the weight being borne by both these cords is distributed equally between them, half being borne by one and half by the other side. Half the original weight therefore applied to one side, either directly or over a fixed pulley, will support the weight on the other side. We thus see that a single moveable pulley halves the power necessary to be exerted, but if the cords be not parallel a different result takes place.

By increasing the number of moveable pulleys, we increase the power of the machine, as in this system (*fig.* 37), in which we have three supporting a weight of 12 ounces by an ounce and a half. Let us go through this system. The first pulley supports a weight of 12 ounces by its centre, this is halved by the two suspending cords, and therefore a force of six ounces only presses on the centre of the second pulley. This force being again equally divided exerts upon the centre of the third pulley a force of three ounces, which being again divided gives us, as the tension of the last cord, a force of 1½ ounces. We may therefore easily calculate the power by dividing the weight as many times by two as there are moveable pulleys in the system.

If each of the ropes instead of being attached to fixed points are curved over fixed pulleys and

Fig. 37.



then attached to the centre of the moveable pulleys, we shall then have three lines to each pulley, and the force will therefore vary in a treble instead of a double proportion.

Fig. 38.

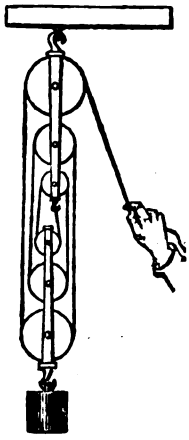


Fig. 39.

We may improve upon these arrangements by combining all the moveable pulleys in one frame as in *fig.* 38, using one rope, one end of which is fixed, carrying it alternately under a moveable pulley and over a fixed one. It will be still better if the pulleys are arranged side by side (*fig.* 39), having the same axis of motion. We shall then have two blocks, as they are termed, having three pulleys each. The effect, however, will be somewhat modified, for we suspend the weight from the common centre of the pulleys, which are connected together by a rigid frame and consequently have the weight equally distributed between them; as likewise the cords each of which bearing its proportion is strained with a force equal to one sixth of the whole, consequently two ounces will support 12. When therefore the weight is supported by the common centre of the pulleys or sheaves, to obtain the power necessary for equilibrium, divide the weight by double the number of pulleys in the lower block. It is in this form that the

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pulley is principally used. Its compactness and strength make it very convenient for the rigging of ships and many other purposes in which weights are moved by ropes.

The celebrated Smeaton contrived a tackle in which there are ten wheels in each block, five large wheels placed side by side, and five smaller placed below in the upper and above in the lower block. The ropes are arranged as in the diagram, and there being twenty distinct parts or lengths the power gained is 20.

Fig. 40.

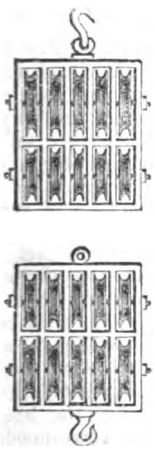
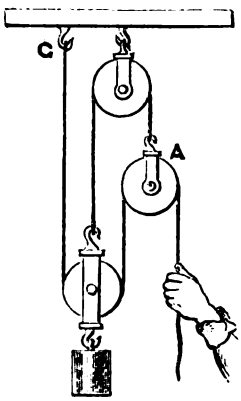


Fig. 41.

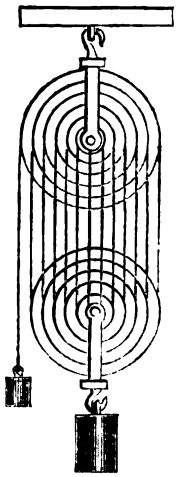


There are several other combinations and contrivances, of which the most noticeable are called Spanish bartons. One is shown in *fig.* 41. It is composed of one fixed and two moveable pulleys. The rope to which the power is applied is fixed at one end and then passes under a moveable pulley to which the weight is attached, and then over another moveable pulley, which is suspended by a rope passing over the fixed pulley and attached to the other moveable pulley. It will at once be seen that the pulley A will be depressed when power is applied, and at the same time the weight will be elevated. The proportion of power to weight is as follows:—a force of one pound is exerted upon the first part of the rope, which therefore pulls down the first pulley with a force of two pounds. A C being drawn with a force of one pound, the other side is depressed in the same manner, consequently the weight is pressed upwards with a force of two pounds, which, added to the other two pounds makes the power or efficacy equal to four.

In the other combination, the rope, after going over the first, instead of passing under the second pulley and being fixed, is attached again to the centre of the first, which as before is attached to the second. The first rope, being here trebled, exerts a treble force upon the first pulley, the rope on which passing to the second pulley, lifts it with a power of three, which being added to the power of two by the two parts of the first rope passing under the second pulley, makes the power of the combination equal to five.

An engineer named White, some years ago patented a curious combination, in which he uses one wheel or sheave only in each block. This

Fig. 42.



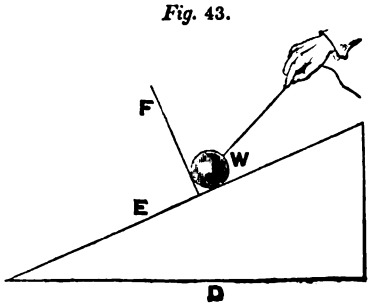
wheel is cut into grooves of different diameters. It is found that if these grooves be made of different diameters and the proportions of these diameters be in the upper block as 1, 3, 5, and in the lower as 2, 4, 6, that they will revolve in equal time. White therefore fixed them together, or in fact turned each wheel of pulleys out of one piece, with grooves of the proportions which I have mentioned.

In all these combinations it will be observed that the velocity, weight, and space passed over diminishes in exact proportion to the power gained; indeed, the various systems of pullies present the best practical illustrations of the great mechanical principle of virtual velocities, or, as the law is expressed by practical men,—Whatever is gained in power or force is lost in velocity

I have already alluded to the principal uses of the pulley. In former days it was used by surgeons for the purpose of reducing dislocations, but in these days of superior information, this barbarous method has very properly fallen into disuse. Indeed as Dr. Arnott remarks, if any man should so ignorantly stretch his patient on the rack, he would be fairly requited with similar treatment.

Inclined Plane.—The inclined plane is the most simple of all machines. It is merely some plain hard surface, forming any angle with a horizontal plane which is less than a right angle. A part of the weight is resisted by the plane, and produces a pressure upon it, and the remainder urges the weight down the plane and would produce a pressure

Fig. 43.



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against any surface resisting the descent. Let *fig.* 43 represent such a plane and let W be a weight placed upon it. This weight acting vertically is equal to two forces, W F perpendicular to the plane, and W E parallel to it. If now another plane be placed below the weight, it will resist its descent and sustain a pressure expressed by the tendency of the weight down the plane. The weight then resting in the corner, instead of producing a pressure in the direction W P as it would in a perfectly flat plane, produces two, the one upon the inclined plane, and the other upon the resisting plane. These pressures have the same proportion to the entire weight that the lines W F and W E have to the line W D. In fact we have a case of the composition of force, to be resolved by the parallelogram of forces.

We have supposed the weight to be sustained upon the inclined plane by another interposed plane, but the power necessary to support the weight and produce equilibrium will be the same in whatever way it be applied, provided it act in the direction of the plane. Thus a cord may be attached to a weight, or the hands of men may be placed below it. But in whatever way applied the amount of the power will be determined in the same manner. Suppose the weight to consist of as many pounds as there are inches in A B, then the power requisite to sustain it upon the plane will be as many pounds as there are inches in A C.

We thus obtain the principle that the less the elevation of the plane the less the power necessary to sustain a given weight upon it. Thus this roller is now sustained by a certain weight but if the elevation of the plane be increased, the weight no longer sustains it, and it descends the plane; while if the elevation of the plane be diminished the weight preponderates and draws the roller towards the top.

The power of an inclined plane, therefore, considered as a machine or one of the Elements of Machinery is estimated by the proportion which the length has to the height. The amount of pressure on the inclined plane is such a portion of the absolute gravity or weight of the body as the base of the plane is to its length. Thus, the pressure exerted by a body whose weight was equal to 100lbs. on an inclined plane, whose base is 6 feet and length 8 feet would be 75lbs.

Galileo first experimentally proved the laws of falling bodies by means of an inclined plane. Atwood's machine was not then invented, and Galileo, therefore, to overcome the impossibility of experimentally investigating the laws of falling bodies by the direct unmodified action of gravitation, bethought himself of the inclined plane, as opposing an uniform resistance to the force of gravitation, without disturbing the laws of its action.

Roads which are not level, are in fact inclined planes, and loads drawn upon them in carriages are subject to all the conditions which we have thus considered. The inclination of the road is estimated by the height, corresponding to some proposed length. Thus it is said to be one foot in fifteen or one foot in twenty, meaning that if fifteen or twenty feet of the road be taken as the length of an inclined plane, such as A B, the corresponding height will be one foot.

To be Concluded in our next.

THE HOROLOGICAL SECTION OF THE INTERNATIONAL EXHIBITION.

"The contemplation of models is not an unpleasant or useless employment of the mind. It cannot indeed produce perfection; but it produces improvement, and nourishes that generous and liberal fastidiousness which is not inconsistent with the strongest sensibility to merit, and which, while it exalts our conceptions of art, does not render us unjust to the artist."—LORD MACAULAY.

The horological arts were represented in the International Exhibition of 1862, by the displays of 315 exhibitors, of whom 114 were British, the remainder Foreigners. The latter represented their respective countries as follows:

Countries.	*Exhibitors.*	*Countries.*	*Exhibitors.*
Switzerland	74	Denmark	5
France	54	Sweden	5
Baden	18	Saxony	4
Austria	10	Wurtemburg	4
Prussia	9	Italy	4
Hanse Towns	3	Hesse	1
Norway	3	Mecklenburg	1
Belgium	1	Japan	1
Brazil	1	Ruasia	1
Bavaria	1	Spain	1

In the following summary of the display made by English Horologists in support of their profession, the chief object which we have in view is the preservation of a fair record of what they exhibited, taken as an indication of what they deemed necessary to do, both for honour and for profit. From the names of exhibitors we certainly missed many who enjoy a wide and familiar reputation, possibly superior to any necessity for further publicity. But such independance, in our estimation, only enhances the gravity of the charge against them for not upholding the art. The consequent retribution for this apathy and neglect will doubtless arrive in the form of an inference drawn by the public, that the absentees were more of tradesmen than artists. That many put in an appearance, whose absence had been in better taste may be true, but whoever holds such an opinion can base upon it no excuse for the absence of those

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whose sense of duty should have led them there.

On the whole we think the English display was generally admitted to be good. We decidedly think it ought to have been much better. It was certainly too good for the obscure position to which it was doomed in the building; against which, by the bye, one would reasonably suppose that the experience of 1851 might have been usefully employed. However, the selection of the position evinced neither sagacity, discretion, nor common sense, and it could not have been worse had it been elected entirely by chance. There can be little doubt that the art has suffered much neglect by the great bulk of the visitors, in consequence of Class 15 having been located in a gallery instead of on the ground floor.

Taking a very general view of each principal branch of the art, we would make a very few remarks without attempting detailed criticism.

Marine Chronometry was only marked in the Exhibition by a great variety of auxiliary compensation balances, all designed for the purpose of attaining more approximate steadiness of performance with extremes of cold and heat, the most original of which is decidedly Mr. Cole's. The chronometers generally represented much excellence of workmanship, and it is but justice to allude here to the high finish of Kullberg's display.

There were no means of ascertaining either accuracy of adjustments or certainty of performance, beyond the reputation in the trade enjoyed by the exhibitor. The jury for Horological Instruments were very properly instructed to take into account in making awards, the probability of these qualities, and in doing so they must have relied solely upon the experience and knowledge of their professional members. With regard to the chronometer balances, the great variety of construction impressed us with the idea that chronometer makers were too often labouring empirically to accomplish the object in view. Each maker may have one (or more) pet auxiliary balance, which to his satisfaction answers its intended purpose, as he declares, admirably; yet it is notorious that no one form of balance can yet compete with the ordinary construction, as perfected by Earnshaw, who melted the laminæ together. The matter, it would seem, is seldom well considered in its theoretical bearings by the persons who become (perhaps suddenly) possessed of ideas for forms of construction for compound balances. The balance is worked out, tried, and the labour of manipulation having been great, the artist prides himself on its success, whether deserved or not. Mr. Loseby went into the subject with real scientific inductive reasoning, and produced his mercurial tube auxiliary balance, which theoretically appears perfect, but practically is objectionable, as being brittle, difficult of construction, and expensive. Mr. Hartnup also treated the subject scientifically, and we believe his balance has been very successful in the hands of several artists; its difficulties of construction, however, are not denied by its author. But for many of the host of new designs, trivial most of them, we know not where to direct our hands to reach the book or the specification in which their nature, details and results can be found described.

The display of *Watches* was marked principally by varieties in appended mechanism, in the form of fancy seconds, keyless works, reversible cases, metallic thermometer, and elaborate ornamentation; accompanied in some instances, as in the displays of Rotherham, of Benson, and others, with artistic designs beautifully engraved and chased.

The *Clock* division was greatly deficient in variety and display of invention; electricity and gravity escapements yielding the only grounds for operation. Mr. Cook, of York, distinguished himself for judicious form and adoption, both in the great work and escapement, for turret machinery. Mr. Hislop exhibited a successful adaptation of the train of wheels to shew sidereal time, driven by the mean time train, in one clock, which is a useful combination for observatories. Some highly artistically designed clock cases were displayed by T. Cole, White, and Howell & James.

The exhibition, as regards *Tools* and *Machinery*, for which such a wide field of improvement is open in the Horological Trades, was undeniably unsatisfactory.

With these prefatory remarks we take up the replies to our circular (Vide p. 31) in the order in which they reached us; and here we wish to tender our thanks to the respondents for the information which they have sent us, and to state that we have availed ourselves of it largely, but at the same time have taken all possible pains to ascertain that what is herein stated is accurate and deserved.

Rotherham & Sons, *Coventry*, had upwards of one hundred gold, and fifty silver, watches at the Exhibition, intended as a fair sample of the goods which they regularly make, both as regards style and workmanship. Some of the engraving and enamelling was very fine, executed by some of the best hands in the trade regardless of expense. They also showed an ordinary 20-size silver lever watch, with each part of it in every

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stage of manufacture, showing first of all the rough brass, steel, &c., and finally the finished movement. Likewise a ¾-plate movement, with as much of the plates cut away as possible, exposing all the work, in order to give the general public some idea of the position of the wheels &c. These partitive displays were, by these and many other exhibitors, very elaborately got up and beautifully displayed; they are very instructive, and the inquisitive public take more delight in their examination than in the inspection of the most artistically-finished instrument.

Messrs. Howell, James, & Co., *Pall Mall*, exhibited a variety of shapes in travelling clocks, such as padlocks, horseshoes, crosses, &c., deserving of notice from their novelty; also elaborately-ornamented clocks with candelabra in English ormolu, illustrating the gothic, moresque, and Elizabethan styles. These latter were designed by Mr. F. E. Hulme, Art-teacher at the School of Design, South Kensington, and are executed in English ormolu. They are works of high artistic merit, both in point of design and also as examples of beautifully-finished metal-work. The moresque ornamentation is composed of the well-known conventional foliage, the peculiar feature of this style, a further lightness and grace having been obtained by piercing the leaves with tracery of elaborate scroll-work inlaid with occasional jewels of pink coral, which has a pleasing and novel effect on the mellow gold tint of the ormolu.

S. A. Brooks, *Northampton Square*, besides a large assortment of various kinds of watch-jewels, displayed his "export case of watch-jewels with set of gauges." Mr. Brooks, who has worked out his system of gauging watch-jewels and supplying them in various sizes, from an extensive experience of the requirements of the trade at home and abroad, has kindly placed in our hands a description of his invention which will be found in another page.

Thomson & Profaze, *New Bond Street*, not only refused to give the information desired, but replied to our circular in a manner which we consider unbecoming. We therefore content ourselves by remarking that they made a good display of watches, clocks, and jewellery. To the account of their display in the Official Illustrated Catalogue is added, "Further particulars may be learned on application;" they are, we think, the only exhibitors who make this promise in the Catalogue,—how well they have kept it, our readers can now judge for themselves.

C. J. Hill, *Coventry*, exhibited an assortment of watch dials manufactured from solid pieces of mother-of-pearl, together with finished gold and silver watches, most of which had pearl dials. The principal stated advantages of these dials are,—their beautiful natural appearance; their capability of being engraved, ornamented, and sunk to any style; their durability and cheapness. The centre can be engine-turned, engraved, or ornamented with gold pierced work, the latter style being suitable for ladies' gold watches. The pearl can also be introduced on the backs of engraved cases, or the backs can be made of one piece of pearl. Some of each style were exhibited, and also a dial large enough for a time-piece.

Joseph Sewill, *Liverpool*, was, with one exception, the only Liverpool exhibitor, though that town is not wanting in manufacturers of chronometers. His display consisted of pocket chronometers, winding with or without keys, marine chronometers, duplex and lever watches, including independant dead centre seconds with chain and fusee; centre seconds and compensated watches of various descriptions, and improved time-keepers for scientific and engineering purposes.

Porthouse & French, *Northampton Square*, exhibited samples of such kinds of watches as sell in the greatest quantities in most of the foreign markets. Subsequent to the inspection of the jurors, they finished and exhibited two watches of very superior construction; they have lever escapements, but are sprung as chronometers, *viz.* with spiral pendulum springs; one of them possesses an auxiliary compensation to the balance, to enable it to withstand a much greater range of temperature. They believe these lever watches to be as excellent and accurate as chronometers, with the advantage of being much less expensive.

E. D. Johnson, *Wilmington Square*, was a juror for Class 15, and consequently excluded from competing for award. He exhibited a diversified collection of horological instruments and models. His case contained,—Firstly, Watches: Duplex and lever, in three forms, *viz.* half, three-quarter, and full plate; railway, automaton, and keyless watches, the two latter in combination; also a variety of gold and silver watches in all the above forms and combined, altogether eschewing ornamentation. Secondly, Chronometers: "pocket," full plate and half plate; "marine," eight-day and two-day; a "surveying," or combination of pocket and box chronometer, an ordinary small-sized two-day movement, fitted in a silver case as well as the ordinary gimbals, so as to make it portable in the pocket as well as suitable to the purposes of navigation, being remov-

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able from its gimbals by turning round the glass cover; "magnetic disperser" for marine chronometers, being machinery fitted in the box, which causes the chronometer to revolve on its own axis in twenty-four hours, thus subjecting the instrument in all positions to the inductive influence of the magnetism of the ship, and preventing the balance and steel work from acquiring magnetic polarity. Thirdly, Models: specimens of train and dialwork of the "universal seconds watch," a new design, effecting the union of "automaton seconds" and permanent side seconds without complexity; groups of watch movements, showing various constructions and qualities of workmanship; models of mercurial pendulums, improved in form for facilitating the execution, and fitted with an iron plunger for determining any symmetrical form of surface for the mercury, and consequently enabling the compensation to be arranged to the thermometric scale; new suspension for pendulums, consisting of simple but effective adjustable support, the spring closely approximating to isochronism; a new rotatory driver for circulating pendulums, consisting of a single crank motion, suitable for equable continuous rotary motion required for equatorial telescopes; a new auxiliary compensator for wooden pendulums, inexpensive and adjustable, requiring simply to be hung on the rod, being composed of a glass tube drawn out into an upper and a lower chamber divided by a long narrow neck partly filled with mercury and regulated by a screw in the bottom, fixed in a piece of boxwood for support. Lastly, we must mention the model of a public electric time-ball. Mr. Johnson also exhibited a portrait of the celebrated horologist Earnshaw, lent by Benett Woodcroft, Esq. It would greatly enhance the interest of the general public, if in future exhibitions of horological instruments and implements, portraits of the fathers of the trade, explanatory diagrams, and short legible descriptions were displayed. For want of any attempt, even at such popular elucidation of the history and scientific principles of horology, at the late exhibition, thousands of visitors wandered through the court without giving scarcely a glance at the marvels of science and art which it contained. Mr. Johnson's example was not catching, others did not imitate it.

W. Plaskett & Son, *Mile End*, exhibited marine chronometers furnished with air-tight valves intended to exclude all damp from the works, and fitted with improved compensating auxiliary balances for correcting the differences of time occasioned by *extreme* temperature. This auxiliary balance is designed to correct the errors in the ordinary compensation balance, and is said to maintain a uniform rate of going from the freezing point to 100° of temperature. Our readers would doubtless be glad to receive from Messrs. Plaskett a detailed description of their auxiliary compensation balance; or if not their own to know whose balance was employed.

John Jones, *Strand*, displayed a great variety of elegant watches, aiming at cheapness of production without sacrificing either beauty or geometric precision. Some of his gold watches had a new application of jewels in the notation of minutes on the dials, others a novelty in the way of colour combined with gold for illuminating enamelled dials; both kinds designed for ladies' use. He had also "railway watches" with compensation balances and isochronal springs; "hunting" lever watches with spring caps, a new and convenient arrangement for effecting increased flatness; and two-day watches with correct adjustments, suitable for travellers.

S. Holdsworth, *Islington*, showed a collection of every description of clock, chronometer, and watch jewel-holes, comprising diamonds, rubies, sapphires, chrysolites, garnets, and aquamarines of the best workmanship, and of every admitable size in hole, varying in their differences some 500 degrees; watch and chronometer pallets and pallets for turret clocks, ruby duplex rollers, ruby cylinders, and solid rollers for chronometers, which answer the purpose of both roller and impulse; ruby pins, flatted, oval, and triangular; caps and points for marine compasses; draw-plate holes for making gold wire, drawing from 500 to 2000 yards to the ounce; diamond points for microscopic writing capable of drawing a line the 5000-th part of an inch, others suitable for steel engraving; diamond and sapphire files for shortening stone pallets and reducing hard steel; likewise samples of every description of stone in the natural state, and as used for horological purposes. This it will be evident to those who did not examine the display with the technical knowledge necessary to appreciate the utility and beauty of the many articles and implements exposed to view, was a case well representing Mr. Holdsworth's particular branch of horology.

T. J. Wood, *Long Lane*, had on view fair samples of Black Forest Clocks, in which gravity is both the maintaining and regulating power. He had a good variety of the "silent," "striking" and "alarum" descriptions of different sizes, styles, and prices.

We propose to give a short notice of the Black Forest Manufacture in our article on German Horology.

(To be Continued.)

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WATCH JEWEL-HOLE GAUGE,

Invented by S. A. Brooks.

The want of some mode for determining the size of watch jewel-holes has long been felt. The present invention called the jewel-hole gauge is intended to meet this requirement, and there is little doubt but that when its utility becomes generally known, it will be regarded almost as an indispensable article by every watchmaker. To those in the trade, and to material dealers resident abroad, its advantages are peculiarly adapted on account of the facility that its use will afford for selecting to the greatest nicety any requisite number of watch jewels, either from the export jewel case, or from a stock on hand, which could not be done but for the gauge. Another advantage is, that persons at a distance from the watch jewel manufacturer, will be enabled by mere reference to the number of the gauge to replenish their stock by obtaining jewels of uniform description, and properly classified, or to obtain any particular size jewel of which they may stand in need.

To understand the utility of the invention, it must be borne in mind that English made watches can only be jewelled in London, Coventry, or Liverpool; that is to say, the production of watch jewels is confined to those three places. If, therefore, by any means a new jewel is required for an English made watch, it must be obtained in the first instance from one or the other of the places mentioned, and the watchmaker to whom the watch is entrusted has to forward there the watch, or a material part of it to have a jewel fitted to it. No matter how far distant the watchmaker resides, if it be in India, there is no alternative for him but to adopt this course, or to replace the damaged or worn out jewel with metal, thereby destroying the time-keeping property of the watch or chronometer.

An attempt has certainly been made of late years to meet this difficulty, by exporting manufactured watch jewels, but on account of there having been no system of measurement adopted, it has frequently been the result (as a Charleston watchmaker states), that after spending hours in searching through a considerable stock of jewels, not one of the correct size could be found.

Again, as the production of watch jewels of uniform size and completeness, requires a considerable amount of ability on the part of the workman, it is but natural to suppose that the system of gauge will secure a better description of jewel; since it has been the practice with many manufacturers, to employ lads in the production of watch jewels, who are only able to produce an indiscriminate assortment without any regard to utility or to uniformity of size.

It is a fact, that watch jewels vary in the diameter of the holes from one two thousandth part of an inch; and therefore if a strict adherence to the principles of measurement, and classification be observed, experienced workmen must be employed to ensure correctness in size, for the slightest variance in this respect renders the jewel totally unfit for its purpose.

Another great advantage of the jewel-hole gauge is, that its usefulness is not confined to any particular description of jewel, it can be applied to all kinds of jewel holes.

The gauge is, for the convenience of the purchasers, divided into ten parts, each part adapted to a special purpose, so as to enable persons who do not wish to possess the whole, to procure such portion of it as may be best adapted to their use.

The following Table of Divisions, will readily show the applicability of each of the ten parts of the gauge.

Gauge.	Holes.	
1 ..	1 to 12	inclusive, will gauge the escapement pivots to any modern watch.
2 ..	13 to 24	inclusive, will gauge the small wheel pivots of three quarter plate and small frame watches.
3 ..	25 to 36	inclusive, will gauge the small wheel pivots to large frame watches.
4 ..	37 to 48	inclusive, will gauge centre wheel, also chronometer third and fourth pivots.
5 ..	49 to 60	inclusive, will gauge chronometer seconds pivot.
6 ..	61 to 72	inclusive, will gauge regulator and clock work pivots, also lower fusee and hollow centre pinions to watches.
7 ..	73 to 84	inclusive, will gauge small three quarter plate fusee upper pivot.
8 ..	85 to 96	inclusive, will gauge large three quarter plate fusee upper pivot.
9 ..	97 to 108	inclusive, will gauge frame fusee upper pivot.
10 ..	109 to 120	inclusive, will gauge large frame fusee upper pivot.

The saving of time to the watchmaker who keeps a stock of watch jewels on hand, by adopting the system of the gauge will be very great; as the invention furnishes him with a standard of measurement, just as a carpenter by the aid of a rule is enabled to determine the size of the material he re-

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quires, and by the same means to make a selection with accuracy.

In order to make the invention still more acceptable to watchmakers, and material dealers resident abroad, the inventor manufactures, in connection with it, an export watch jewel case, with assorted set-jewels arranged so that any required size may be instantly found. This will be of great service, since a broken jewel can be immediately replaced from it with the greatest accuracy, at a cost of little more than one third the usual charge, and without the loss of time attending the ordering and transmission of a jewel from the place of manufacture.

The engraving is descriptive of the watch jewel-hole gauge, in connection with the export watch jewel case. The pivots are arranged along the sides of the case and they are numbered so as to correspond with the various boxes containing the jewels, and designed to gauge the hole should the pivot of the watch be broken.

The case can be manufacted so as to contain any number of jewels according to the wish of the intending purchaser. S.A.B.

COCK WATCH JEWELS. Size Hole—5. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—5. Size Setting, 27 to 50.
COCK WATCH JEWELS. Size Hole—10. Size Setting, 30 to 53.
COCK WATCH JEWELS. Size Hole—12. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—12. Size Setting, 27 to 50.
COCK WATCH JEWELS. Size Hole—6. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—6. Size Setting, 27 to 50.
FOOT WATCH JEWELS. Size Hole—10. Size Setting, 27 to 50.
COCK WATCH JEWELS. Size Hole—13. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—13. Size Setting, 27 to 50.
Jewel Hole Gauge
Inventor J. A. Brooks
10, Northampton Sq.re
LONDON
1862
COCK WATCH JEWELS. Size Hole—7. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—7. Size Setting, 27 to 50.
COCK WATCH JEWELS. Size Hole—14. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—14. Size Setting, 27 to 50.
COCK WATCH JEWELS. Size Hole—8. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—8. Size Setting, 27 to 50.
COCK WATCH JEWELS. Size Hole—11. Size Setting, 30 to 53.
COCK WATCH JEWELS. Size Hole—15. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—15. Size Setting, 27 to 50.
COCK WATCH JEWELS. Size Hole—9. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—9. Size Setting, 27 to 50.
FOOT WATCH JEWELS. Size Hole—11. Size Setting, 27 to 50.
COCK WATCH JEWELS. Size Hole—16. Size Setting, 30 to 53.
FOOT WATCH JEWELS. Size Hole—16. Size Setting, 27 to 50.

Edinburgh Horological Society.—The first half-yearly meeting of the above society was held on the evening of Friday last in the society's room, Goldsmith's Hall, when the Secretary (Mr. M'Kay) gave his report of the society's proceedings for the last six months. The Report showed that the society was in a very prosperous condition, there being upwards of thirty journeyman watch and clock makers enrolled as members. The retiring president, vice-president, and the secretary (Messrs. J. L. Donald, D. Meek, and E. M'Kay) were then re-elected; the following gentlemen were elected Members of Committee: Messrs. D. Spence, R. Wilson, W. Lyme, R. Falconer, D. Mitchell, and P. Adair. Mr. J. Thomson was then elected treasurer (the secretary having intimated, after being re-elected, that he could not accept both offices.)

The Essay for the evening, entitled The Verge and Horizontal Escapements, was read by Mr. Gray, for which he was awarded a cordial vote of thanks by the members.

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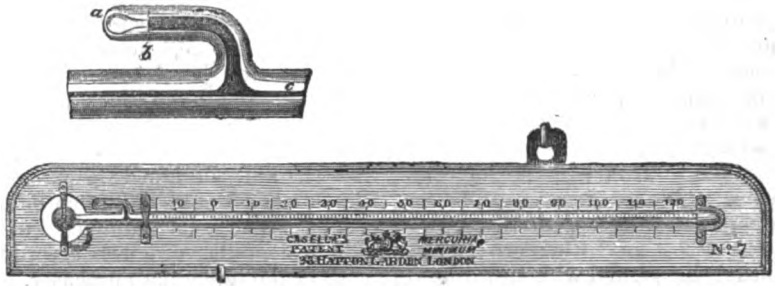
MERCURIAL MINIMUM THERMOMETER, *Invented by* L. M. CASELLA.



This very ingeniously devised thermometer is, we are informed, the invention of the son of Mr. Casella the well-known optician of Hatton Garden. We have much pleasure in being permitted to make our readers acquainted with it. It is not an untried novelty; on the contrary it is patented, has been many months before the public, and has been severely tested by some of the best meteorological observers. Among others by Balfour Stewart, Esq., Director of the Kew Observatory, who reported to the British Association that he had carefully tested its action, and found its indications in every way satisfactory. The invention is intended to supply the long-felt want of some means of registering past cold with the same fluid as that employed to register heat, *viz.* mercury instead of alcohol. The latter, from its volatility, and the intervention of gaseous partitions in the spirit, proves a constant source of uncertainty in this country, whilst in tropical climates these defects become intensified. The difficulty was to discover some means by which the mercury itself might be detained at the minimum point.

In various experiments conducted by L. M. Casella for this purpose, it occurred to him that the adhesive property of mercury for glass in vacuo, together with the fact that where two tubes are united to one bulb this fluid will rise by expansion in the larger and recede by contraction in the smaller tube, might enable him to obtain the end in view. The result is the invention of an instrument to register past indications without having or forming any separate index, and in which the adhesive property of mercury for glass as a fixed point is employed.

The general form and arrangement of the instrument is shown by *fig.* 2.

In *fig.* 1 is represented a full-sized section. *d*, is a tube with a large bore, at the end of which a FLAT GLASS DIAPHRAGM is formed by the abrupt junction of the small chamber, *a b*, the inlet to which at *b* is larger than the bore of the indicating tube; the result of this is that on setting the thermometer as described below, the contracting force of the mercury in cooling withdraws the fluid in the indicating stem only, whilst on its expanding with heat the long column does not move, the increased bulk of mercury finding an easier passage, *viz.* into the small pear-shaped chamber attached.

To set the Instrument, place it in a horizontal position, with the back plate, *e*, suspended on a nail, and the lower part supported on a hook, *f*. The bulb end may now be gently raised or lowered, causing the mercury to flow slowly until the bent part, *d*, IS FULL, and the chamber, *a b*, QUITE EMPTY. At this point the flow of the mercury in the long stem of the tube is arrested, and *indicates the exact temperature* of the bulb or air at the time. On an increase of temperature the mercury will expand, as above explained, into the small chamber, *a b;* and a return of cold will cause its recession from this chamber only, until it reaches the diaphragm, *b*. Any further diminution of heat withdraws the mercury down the bore to whatever degree the cold may attain, where it remains until further withdrawn by increased cold, or till re-set for future observation. By this means present temperature may be known, and cold registered to any fraction of a degree observable on the most sensitive standard thermometer. There is no separation of the mercury in any of its indications, and no vicisitudes of climate or transit can disarrange the instrument. When out of use, or after transit, it may be that raising the bulb may not at first cause the mercury to flow from the small chamber, as above; in such case, however, a slight tap with the hand on the opposite end, with the bulb up, will readily cause it to do so.

TRIALS OF CHRONOMETERS AT GREENWICH.

The following letter has been received by *The Journal Committee* from the Astronomer Royal, in reply to Mr. G. H.'s letter respecting the mode of determining the qualification of chronometers at the Royal Observatory, Greenwich.

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Royal Observatory, Greenwich, London, SE. 1862, *October* 22.

SIR,—The principle on which the order of merit is assigned to chronometers in the trials at the Royal Observatory is correctly described in the paper to which you referred me, *Horological Journal*, vol. v. page 9.

This principle has been adopted as well suited to the wants of the royal navy, but may not be so well suited to every other conceivable case.

Chronometer rates are subject to irregularities of two distinct kinds. One is the irregularity from week to week; this may be supposed to arise from inferior workmanship; it is important in short voyages, but not very important in long voyages except it grows up into the other irregularity. The other is the irregularity in long periods; this will usually arise from defect in compensation, or from change in the state of the oil, combined with want of isochronism; it is injurious in long voyages, and unimportant in short voyages.

The relative importance of these two classes depends therefore upon the service in which the chronometers are likely to be used. For the general service of the royal navy the different weights are given to the different classes of errors in the proportion which you have described. I am, Sir, your obedient servant, G. B. AIRY.

SOLUTION OF PROBLEM, PAGE 35.

	M. S.		D. H. M.	
Long. Plymouth 4° 7′ 20″ w	16 29·33	.. or ..	0 0 16·5	
Chron. fast	15 36	local time, Oct.	22 20 30	
,, slow	53·33	of G. mean time	22 20 46·5	

To find Latitude of Ship.

Difference lat. = 12 × cos. 6 points = ...	0° 4′ 35″·5	S
Latitude of the Point	36 6 40	N
,, ,, Ship	36 2 4·5	N
Middle latitude	36 4 22·2	

To find Longitude of Ship.

Diff. long. = 12 × sin. 6 pts. × sec. 36° 4′ 22″·2 = ..	0° 13′ 43″	E
Longitude of the Point	5 21 45	W
,, ,, Ship	5 8 2	W

	M. S.		D. H. M.
Chron. fast ..	17 53	of local time	Nov. 3 3 45
Long. in Time	20 32·13	.. .. or	20·5
Chron slow ..	2 39·13	of G. M. T.	Nov. 3 4 5·5
,, ,, ..	0 53·33	,, ...	Oct. 22 20 46·5
,, lost ..	1 45·8	.. in an interval of ..	11 7 19

That is, the Chronometer lost 105·8 seconds in about 11·3 days, or 9·36 seconds daily.

Chron. slow G. M. T. on Nov 3rd. at H. M. 4 5·5 P.M.	M. S. 2 39 13	
Corn for Rate = S. D. 9·36 × 0·17 = ...	1·59	
Slow Nov. 3rd. at noon for G. M. T.	2 37 54	

R. G. W.—Solved this problem very creditably, using *statute* instead of *nautical* miles, and obtaining for the results, slow 2m. 45s. losing 10s.

John Nimmo, Castle Street, Edinburgh, will see that his solution was not in accordance with the above.

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Obituary.

James Adams, Esq. of the eminent firm of F. B. Adams & Son, of St. John's Square, died at St Leonards-on-Sea, on the 11th November, in the 52nd year of his age. The British Horological Institute thus loses one of its earliest and most liberal promoters—its first Trustee—its first influential trade supporter. While ever mindful of the high and long-standing reputation of the house he represented he placed a liberal confidence in youth, whom he ever acknowledged it to be the duty and privilege of age to guide and support. He was greatly esteemed in private life, and will be remembered with great regret by his numerous friends, and by the Members of our Institute.

METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., October, 1862.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F. and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	30·071	51	48 7	66	47	W	4½	bc	b, or
2	30·155	60 5	58	61	49	SW	4	o	op
3	30·318	63	60	64	60	SW	4	bc	bc, bm
4	30·470	57·5	56	68	52	NW	2	om	o, b
5	30·464	57·5	55	61	51	NE	2	bm	bc, b
6	30·111	59	57	63	53	SSE	3	o	o, b, r
7	30·048	52 5	49·7	65	50·5	NW	3	cb	rr, b
8	30·335	56	55	56	50·5	E	3	b	b, cb
9	30·328	57·6	55	60·5	52·5	ESE	4	c	b
10	30·148	56	55	62	51	SE	2	bm	bcm, tlrr
11	29·891	57·5	56	66	54	SSW	2	r	o, p, bc
12	29·775	59·8	59·2	63	55	SSW	3	r	r
13	29·846	54·5	52	64	51	SW	5	c	o, r, c
14	29·907	60·8	58·5	61	53·5	SW	3	bm	o, c, b,
15	29·657	66	61	66	60·5	S	5	b	c, r, c
16	30·001	51·5	48·7	68·5	49	WSW	2	b	b, bm
17	29·620	54·5	53·3	57	51	SW	9	r	r, b
18	29·682	50	47	57	44·7	SW	4	o	rr, b
19	29·770	47·5	45	50	39	S	4	bm	bc, rrqq
20	29·281	47	44	56	45	W	5	cb	c, b
21	29·730	46·5	43·5	50	43	WNW	3	o	b, r
22	29·520	54·5	53·7	55	46	SW	9	r	r, o, b
23	29·358	50	46	60	47	WSW	8	bc	bcqq
24	29·653	44·6	42·5	54	41·5	W	3	bm	cb, r, bm
25	29·974	43	41·5	51	37	SW	4	mc	bcm,
26	29·600	54·5	54	55	41	SW	4	r	o, b
27	29·980	51	48	55	43	SW	4	c	o, qr
28	29·831	51	49	56	49	NNW	1	o	f, o, r
29	29·946	46 7	45	50	46·7	N	1	m	o, bm
30	29·949	40	39	48	34	NE	1	mr	f, o, r
31	29 727	50	49·5	50	37·5	SE	1	fr	fr
	29·908	53·3	51·1	58·7	47·9		3·6	Mean.	

Remarks.

The atmospheric pressure attained to 30·494 inches of mercury at midnight 4th, and was as low as 28·967 at 11½ p.m. 19th; so that the extreme range was 1·527 inches.

On 17th a strong gale blew from S, veering to W.

On 18th there was heavy rain from 10 a.m. until 5 p.m., the gauge collecting 0·71 of an inch.

About 6 p.m. 19th, a violent gale sprung up with the wind at SSE; the barometer had been falling all day, but the rate of fall now became one-tenth of an inch an hour, until 11 p.m. when the lowest reading was obtained. At 11h. 45m. the mercury began to rise. The violence of the wind was almost unprecedented especially in the squalls, and the rain at times was very heavy. The storm abated somewhat after midnight and may be said to have terminated about 4 a.m. with the wind in NW, having veered through the SW quarter. The amount of rain was 0·51 inches.

On 22nd a fresh gale prevailed from SW. The wind attained to a strong gale also on the 23rd from SW to W.

During the night of 26th a gale blew from SW to NW.

During the night of the 27th there was a similar gale from SSW to W and N.

This remarkable series of storms was highly disastrous to life and property at sea.

Rain fell on 21 days, during about 94 hours, to the amount of 3·23 inches.

According to the 9 a.m. observations, the wind blew from the N on 4 days; E, 4; S, 11; and W, 12.

TO CORRESPONDENTS, &c.

All Communications for this Journal should be addressed to the Editor, *at the Office*, 35, Northampton Square, Clerkenwell.

The Journal is always open to Members, who are invited to communicate letters, extracts, or papers, relating to applied Science, but preference will always be given to matters relating intimately or remotely to Horology.

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MECHANICS.

Tenth and Concluding Lecture delivered to the BRITISH HOROLOGICAL INSTITUTE.

BY W. HISLOP, ESQ., F.R.A.S., HON. SEC.

(*Concluded from page* 40.)

The Pulley, Inclined Plane, Wedge and Screw.

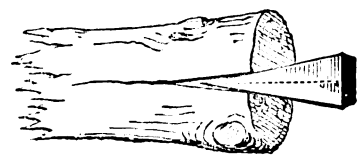
According to this method of estimating the inclination of roads the power requisite to sustain a load upon them, setting aside the effect of friction, is always in proportion to that inclination. Thus if a road rise one foot in twenty, a power of one ton is sufficient to sustain twenty tons. We can easily see, that in fact the power is employed in raising the weight through the height of the plane. If the road rise one foot in twenty, the load will be raised one foot for every twenty feet passed over. Therefore if the energy of the power be such as to raise the weight one foot per minute, the same power would on the inclined plane pass over as much space as corresponds to the rise of one foot. Accordingly if two roads rise, one at the rate of a foot in fifteen the other at the rate of one in twenty, the same expenditure of power will move the weight through fifteen feet of the one and twenty feet of the other at the same time. It is therefore often more expedient to carry a road through a circuitous route, than to continue it in the most direct course, for though the actual length may be considerably greater in the former case, yet more may be gained in speed by the same expenditure of power, than is lost by the increase of distance.

If the power act obliquely to the plane it will have a modified effect, a part being expended in supporting or drawing the weight, and a part in diminishing or increasing the pressure on the plane. It sometimes happens that a weight upon an inclined plane is raised or supported by another weight upon another inclined plane. It is not necessary that the two inclined planes should form an angle with each other; they may be parallel or in any other position, provided communication be made between the weights by ropes and pulleys. This method of moving loads is frequently applied in collieries or other works where railways are used. Loaded waggons descend one plane while other waggons, either empty or partially loaded, are drawn up the other.

The Wedge.—In the instances of the inclined plane which we have thus noticed it is supposed to be fixed, while the weight or load is moved upon it. But it may happen that resistances are to be overcome which do not admit of being thus moved. In these cases the plane is moved under or against the load. Thus when a beam has to be lifted, it is done by a force applied to the back of the inclined plane. When applied in this manner, the inclined plane is called a wedge, and if the power applied was a continuous pressure the effect would be precisely in the same ratio as with the inclined plane.

In some or indeed in most cases, the wedge is formed of two inclined planes placed base to base, and is then impelled by percussion. We then have a sudden impulse opposed by a constant force and a large amount of friction. This renders the theoretical estimation of the value of the power of no practical use, for the force of a blow is of a nature so wholly different from continued forces, such as the pressure of weights or the resistance offered by the cohesion of bodies that they admit of no numerical comparison. In a general way however we may state that the wedge is more powerful as its angle is more acute.

Fig. 44.



Wedges are used when an enormous force is to be exerted through very small spaces. They are employed for splitting masses of timber and of stone, also for raising ships in docks by being driven under their keels. It is likewise used in some oil mills, especially in Holland and France where large quantities of oil are expressed from rape seed and called colza oil. The seeds are placed in hair bags between planes of hard wood; wedges inserted between the planes are driven by the fall of heavy beams, and the pressure is so intense, that the residue of the seed forms a mass nearly as solid as wood.

Wedges have even been used for restoring a tottering edifice to its perpendicular position. All cutting or piercing instruments, as knives, razors, scissors, chisels, nails, pins, needles and awls, are wedges. The angle is made more or less acute according to the purpose to which it is to be applied. The mechanical power is increased by diminishing the angle, but the strength of the tool is diminished by the same means. There is therefore a practical limit to the increase of the power and consequently that degree of sharpness must be given to the tool which is consistent with the strength necessary for its intended purpose. In tools for cutting wood the angle is generally about 30°; for iron it is from 50° to 60° and for brass from 80° to 90°. Tools which act by pressure may be made more acute than those which are driven by a blow.

The presence of friction is absolutely necessary to render the wedge practically useful as a mechanical power. The power acting by successive blows is intermitting in its nature, and but for the friction the wedge would recede, between the intervals of the blows, with as much force as it had been driven orward. But for friction, nails, bolts or spikes

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used for fastening substances together would not hold. We thus see how an element which seems so much to militate against the perfection of machinery yet has its uses, and in fact becomes a necessity in the superstructure of mechanical truths.

The Screw.—I have already adduced as an instance of the inclined plane, a road ascending a hill. It will be still an inclined plane if it be made to wind round a hill, and gradually ascends so as after several revolutions to reach the top. By making a road thus, its steepness will be diminished and although lengthened, the power necessary to reach the top will be less. In the same manner a path may be conceived to surround a pillar for the purpose of facilitating the ascent. Winding staircases in the interior of columns or shafts partake of the same character. In all these cases the winding road, path or staircase, would be equivalent to an inclined plane bent into such a form as to fit it for the peculiar circumstances in which it would require to be used. We shall at once see the resemblance between such an adaptation of the inclined plane and the appearance presented by the threads of a screw, and in fact a screw is nothing more than an inclined plane constructed upon the surface of a cylinder.

Thus if we take a cylinder of wood, a common ruler will do very well, and wind around it an inclined plane of paper, the sloping edge of which is blackened, we shall at once have a graphic delineation of a screw. The same effect may be produced if we take a piece of paper, the breadth of which is exactly equal to the circumference of the cylinder, and upon which we may draw a series of sloping lines or inclined planes at equal distances. The less the inclination of the lines the greater the power of the inclined plane, the closer the spiral, and consequently the finer the threads and the greater the power of the screw. The power is applied at right angles to the cylinder or parallel to the base of the spiral plane either by means of a lever, or when the screw is used to hold substances together, by a screwdriver inserted in a notch across the cylinder which is generally enlarged at the top into what is called a head.

The power is transmitted by causing the screw to move in a concave cylinder, on the interior surface of which a spiral thread is cut corresponding to the thread of the screw, in which this said thread slides when the screw is turned by any means. This hollow cylinder is called the nut or concave screw.

Now if we suppose the nut to be fixed, and the screw to be turned on its axis, it will also be screwed upwards or downwards, advancing every revolution through a space equal to the distance between two contiguous threads. If the screw be fixed the nut will rise and fall if caused to revolve, or if the nut be capable of revolving, or be fixed longitudinally, the screw will rise and fall if prevented from revolving, and vice versa.

As the power of the screw depends on the smallness of the distance between the threads and the consequent smallness of the space through which the screw or nut moves in one turn of the cylinder, it is clear that to increase the power of the screw, we must diminish the magnitude of the threads. Although there is no limit in theory to the increase of the mechanical efficacy by these means, yet practically that increase cannot be carried beyond a certain extent, as the strength of the thread will be so diminished that a slight resistance will tear it from the cylinder. The cases in which it is necessary to increase the power of the machine, being those in which greater resistances are to be overcome, the object will evidently be defeated by the thread being too much weakened.

A modification or variety of the screw, known as Hunter's screw, while it gives the machine all the requisite strength, allows of an almost unlimited degree of efficacy, and therefore obviates this defect. This contrivance consists of two screws, the threads of which differ in their relative properties. One of these works within the other. We will suppose the outer screw to have 20 threads to the inch and the inner one 21 threads to the inch. One revolution will cause the outer screw to descend $\frac{1}{20}$ of an inch; but the inner screw at the same time has risen though the $\frac{1}{21}$ of an inch It follows that the board is depressed not by the 20th or 21st part of an inch but by the difference between the two amounting to the 420th of an inch. Thus making the mechanical efficacy of the screw thus constructed equal to 420. We can increase the power of this combination by bringing the pitch of the two screws nearer together in their proportions. Barlow speaks of an instance in which the numbers were 100 and 101 turns to the inch, giving a power of 10100, but this combination was used for the purpose of measuring, not for the exertion of forces.

The uses of the screw as a mechanical power are multifarious. It is extensively employed in presses, as in the two varieties before you. (*fig.* 45 & 46

Fig. 45.

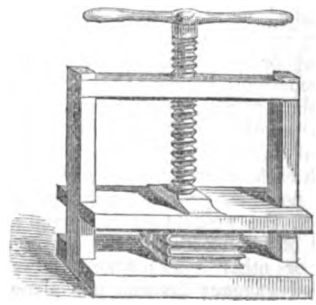
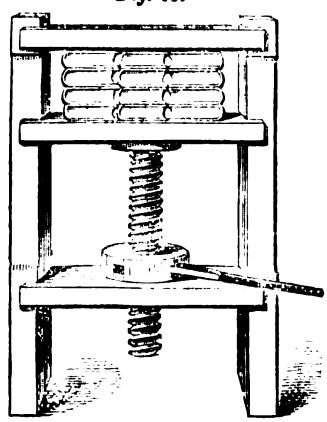


Fig. 46.



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In the first the nut is fixed, and by turning the lever, which passes through the head of the screw, a pressure is exerted upon any substance placed on the plate beneath. In the next the screw is incapable of revolving, but is capable of advancing in the direction of its length. The nut is capable of revolving, but not of advancing in the direction of the screw. When the nut is turned by the lever the screw advances, and urges the head upwards so as to compress any substance between it and the head of the press above.

In the coining press the lever or arm is heavily loaded, and being swung round with considerable velocity the momentum causes the screw with the die attached to descend upon the metal with an accumulated force of impact of enormous power. These presses are called fly presses. The screw s also used in many modifications of the printing and packing presses.

There are a few varieties of the screw which call for our attention:—The first is the Micrometer screw, and is the most simple and yet most useful contrivance which is employed in philosophical instruments. It is intended for measuring minute spaces, and consists of a very carefully executed screw of a known degree of fineness of thread, with a graduated disc fixed on it at one end. Suppose our screw to have 50 threads to the inch, every revolution will advance its end and anything which may bear against it, by the space of $\frac{1}{50}$ of an inch. If the disc or head of the screw be one inch in diameter it will give us a circumference of more than three inches, which may be divided into 100 parts, each of which will be distinctly visible. If we present a fixed index to this graduated circumference the 100th part of the revolution of the screw may be easily noticed by observing the passage of one division beneath the index. As one entire revolution moves the screw through $\frac{1}{50}$ of an inch, a movement through the space of one division of the Micrometer head will be equal to the 5000th part of an inch. In this form it is applied to astronomical telescopes for measuring distances and magnitudes, to microscopes for estimating the sizes of the minutest objects, to sextants, to theodolites, to levels, and in fact to every species of measuring instrument in which exactness is required.

The endless screw is fixed longitudinally, but is capable of revolving an indefinite number of times. It acts upon a toothed wheel, one or more of the teeth taking in between the threads, and being forced forwards as the screw is caused to revolve. It is sometimes used for raising heavy weights, the wheels being connected with an axle around which a rope is wound. Many of the iron revolving shutters of our banks and public shops are raised and lowered by a contrivance of this kind. In the older watches it was employed for setting up the main-spring. It is principally used however for dividing and counting machines. A micrometer head is added in these cases, thus combining the principle of the micrometer with the endless screw. The edges of the wheel or disc which is turned by the screw are generally cut by causing a similar screw properly prepared to revolve against it, thus forming oblique curved teeth upon its edge. Ramsden's dividing engine may be instanced as one of the most perfect of its kind, and as depending upon the screw for its accuracy. A very great advantage attends the application of the endless screw to engines for cutting teeth of wheels, for by the use of a simple table any number of teeth may be cut or any number of divisions marked.

It is evident that the two last varieties of screws which I have described, when used for these accurate purposes, require to be very carefully made, and the pains necessary in their manufacture, render the labour and consequent expense very great. There are several methods of making screws. Small ones are almost invariably cut after the metal is filed, or better still, turned to its proper size, by twisting the blank carefully into hardened steel plates. We may thus have screws almost as fine as a hair. Larger ones are fixed in a vice and the thread is cut with a plate or a pair of dies fastened in a stock. The dies are generally made by taking a piece of steel in which a hole of the proper size has had the thread cut by a tap and dividing it across the middle. After proper hardening and grinding of the face or cut surface, these are carefully fitted in a stock and caused to approach each other by a wedge or screw which forces them onwards till the thread is sufficiently deep. Some stocks are made with several cutters instead of dies and their length varies from a few inches to six, eight, or ten feet. The larger metal screws for presses, steam engines and self-acting machinery are made in lathes in which the cutting tool is caused to traverse along a cylinder, while it is caused to revolve with a speed dependant upon the fineness of the pitch required. The nuts or holes in which screws are to work are tapped, as it is called, by variously shaped taps of the exact size required. The larger ones are generally tapering cylinders with more or less of the sides removed to give a sharp cutting edge.

There yet remains a very old and curious variety of the screw to be noticed, and that is the Screw of Archimedes. Now in this as in other cases, our classical friend Archimedes has got a reputation which does not belong to him, and like many more of our classical celebrities, he has been exalted above his due and proper measure. The invention of this machine is quite unknown; although both Diodorus Siculus and Athenæus, ascribe its origin to the philosopher of Syracuse. The first relates that irrigation was practised in Egypt by a certain machine invented by Archimedes of Syracuse, and called Cochlea from its form. Athenæus states that Archimedes invented it for the purpose of removing the water from the hold of the Greek ship built by King Hiero of Syracuse. Vitruvius describes this machine under the name of Cochlea, but although a admirer of Archimedes says nothing about its being invented by him. On the contrary his testimony goes to prove that it existed in Egypt long before Archimedes. Vitruvius says that it consisted of four or eight laths bent spirally, and fixed at one edge against a cylinder so as to form as many winding channels about it, and that the whole was covered by a cylindrical case, formed of planks nailed over the extreme edges of the laths. The lower extremity was immersed in the water, which running along the channels by the revolution of the machine on its axis was discharged by its upper extremity. Vitruvius adds it was turned by men walking on its outer circumference, so that treadmills, at any rate, are not modern inventions,

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The Screw of Archimedes has been used in modern times for the purpose of raising water from docks, basins, &c., and it might easily be used to raise globular bodies as balls or shells, from the hold of a ship to the top of a wharf. The use of this modification of the screw revolving in water appears to have suggested its application as a propeller to ships instead of the ordinary paddle-wheel. The first vessel to which it was successfully applied was called the Archimedes, but since that time the screw used for the purposes of propulsion has been so much altered, that it would be very difficult for the uninitiated to trace any resemblance to a screw at all.

Friction.—In all these various powers, or elements of machinery, which we have described, we have considered the laws of their action irrespective of the element of friction which always interposes to some extent and therefore requires a separate notice. If a horizontal plane surface were perfectly smooth and another body also perfectly smooth were placed upon it, the smallest force applied to the latter body would cause it to move, and the motion would go on constantly accelerating.

If now we suppose the surfaces of both planes to be studded with a series of little eminences, it will be clear that these must either be passed over or rubbed away before motion can result. Now this is the case with every surface which we can employ. However highly polished, still there will be a certain amount of roughness, and this roughness it is that opposes motion and produces the universal element of friction. If the surface be lubricated with oil or grease, the roughnesses are partially filled up and friction consequently diminishes. To illustrate the cause of friction, we may take a couple of clothes brushes and place them with the bristles towards each other. The bristles of the one become pressed between the bristles of the other, and before we can move the brushes lengthwise, they must be pushed out of the way and the force necessary to do this will be proportional to the distance which the bristles penetrate.

Friction is subject to two laws:—1st, it is proportional to the pressure. If I take this block of wood and place it upon a plane surface and load it with a weight of 1 lb., I shall find that it will require a certain amount of force to put it in motion; load it with 2 lbs. and it requires double the weight to set it going.

The next law is one which we might not expect, but still it can be proved. Friction is irrespective of the surface exposed. That is, whether I have a large or small surface in this block, still friction remains the same, when the pressure is the same. This block is so made that on one side it rests on two narrow edges, and on the other on its whole surface to about 8 or 10 times the same extent. We shall find that the power necessary to move it along the plane is the same in both cases.

Friction is of two kinds, sliding and rolling. Sliding friction we have already considered,—rolling friction is considerably less in its amount, and may be illustrated by the passage of a carriage wheel along a road. If hard and level it runs easily, but if covered with stones or other inequalities, a considerably greater force is requisite.

Friction varies with the kind of surface exposed,—generally speaking dissimilar surfaces have the least friction. In machinery, steel or iron upon brass or gun metal are found to have considerably less friction than steel on steel, or brass on brass. This may be accounted for by supposing that the ultimate atoms of different bodies are different in size, and so cannot penetrate between each other so far as when they are similar. The harder the surface too, the less the friction, and consequently the less the amount of wear. Therefore in delicate works such as chronometers and watches, the holes in which the smaller pivots turn are cut in stones, such as rubies, sapphires, or chrysolites.

We have now concluded our task. We have endeavoured to condense into the preceding lectures the salient features of mechanics as a science, but we must leave the minuter details to be filled up by those who may feel inclined to pursue the subject further by individual study. Our object has been to trace out the foundations of mechanical science, and those who are so disposed may readily find some connection between each group of facts as we have stated them, and the elements of construction of the watch or chronometer. As an instance;—we feel a kind of belief in toothed wheels as an institution by themselves, a sort of natural growth or combination, springing up in the mind which has only become acquainted with their existence in certain definite mechanical arrangements; but if regarded in relation to other mechanisms, we discover that they are but modifications of the lever, and must be dealt with accordingly; so that if the depth of a wheel into a pinion be made too deep, we not only lose power by friction, but absolutely, by the fact that the length of the lever to which the power is applied is shortened in a greater proportion to the diameter of the pinion than of the wheel. In like manner we see that if we diminish the size of the fuzee we diminish the effective power.

But the value of a scientific knowledge of mechanics applies with still greater force to those who are not content with moving in a beaten track but must work out a path of improvement for themselves. It is easy for a mind so furnished to perfect an invention without the aid of models or drawings, and thus to save an enormous outlay of both time and money, and to avoid the occurrence of many disheartening failures.

THE HOROLOGICAL SECTION OF THE INTERNATIONAL EXHIBITION.

(*Continued from page* 43.)

M. F. DENT, *Cockspur St. Charing Cross*,—His display embraced all kinds of first class horological instruments. Of marine chronometers he showed two of the ordinary construction, one fitted with a new auxiliary balance, also a detached balance to show construction. Most of his watches were in gold hunting-cases. One chronometer watch bore a per-

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petual calendar, another was displayed in pieces under a glass shade, being a careful specimen of manipulation and good calliper. A watch for the deaf and blind, having the "*répétition à taot,*" whereby the time can be ascertained by an external hand, was a model in all respects, it had lever escapement, compensation balance, helical spring, fuzee, swivel pendant, and mechanism for winding and setting at the knob. Another watch deserving of a detailed notice was designed for timing the transit of a star, the duration of an eclipse, or for any other purpose where it is required to ascertain the exact time of commencement, continuance, and termination of period of observation. It is a split centre seconds. We cannot afford space to particularize the other watches, suffice it to say that they included repeaters, "*répétition à tact,*" hunters, ladies', highly jewelled, enamelled, and chased of course, and ordinary with key, and keyless, exemplifying Brequet's, the helical, and the cylindrical pendulum springs, duplex and lever escapements. His display of clocks included a miniature regulator with mercurial pendulum, and remontoir train, a portable library clock in bronze case, chiming quarters, a similar one in ebony case, with gongs; and other time pieces in bronze and gilt cases. A chronometer clock, chiming the quarters upon eight bells, with a perpetual calendar indicating the days of the week and month, the phases of the moon, the equation and the bissextile, in a finely finished case of gilt bronze, and crystal glass, had a balance suited to extreme temperatures.

Mr. Dent has promised a detailed description of his new auxiliary balance, which we hope to place before our readers next month.

JOHN FORREST, *Myddelton Street,* displayed 76 specimens of watches, intended to form a complete collection of English watch work, being chiefly commercial samples, but including 12 watch movements in motion, illustrating fine work. Many articles were mounted for show, and taken collectively they represented most of the principles of horology in repute. There were independent dead centre seconds, both double and single train; pocket chronometers; duplex watches, with jewelled pallets; two pin levers with jewel rollers; and other variations in escapements, callipers, pendulum springs, (the different kinds in use), and compensatory balances.

Mr. Forrest exhibited an addition to the ordinary balance of a watch, consisting of a loose bar or cross piece, capable of being shifted to any extent on its collet, for which he claims the production of very extraordinary effects in relation to the equalisation of time in positions. We, of course, are not aware of what experience has been had with it, and cannot pronounce an opinion upon its merit.

WALES and MC CULLOCH, *Cheapside and Ludgate Hill,* in addition to some fine specimens of the best English workmanship, exhibited a watch of the usual size, but possessing an extraordinary combination of qualities. It is termed the perpetual calendar watch, with improved jewel roller escapement; and not only does it perform the legitimate duties of an ordinary timekeeper in respect to hours, minutes, and seconds, but it shows also the day of the week, date of the month, and month of the year; adjusting itself without alteration of the hands, to the long and short months, including even leap year, with its extra day in February.

A. WATKINS, *Strand,* exhibited a model of his direct action timekeeper, and examples of watches on the same principle.

A watch manufactured on this method, Mr. Watkins says, has only 31 pieces in it, whereas one of the ordinary kind has 63.

It is a going-barrel watch, having one wheel less in the train than is usually employed. Of course, the absent wheel has to be accounted for by alteration in the numbers of the teeth of the wheels and pinions.

NUMA STRAM, *Ashby Street, Northampton Square,* had on view cases for keyless and reversible watches combined. The method of reversing is different from that usually adopted, and is thus described in the patent dated April 10th, 1862:—"The interior case, which contains the watch movement, is fixed on a pivot adapted to a point fixed on the middle part or "collier" of the exterior case, so that by reversing the interior case on this pivot, a hunting watch or an open-faced watch is obtained. The winder consists of a head fixed on the end of an axis connected with the works of the watch; this head is exactly opposite to the pivot uniting the two cases, so that the head always comes to the same point of the middle piece of the exterior case; at this point an opening is made to admit the head; this opening is made in such a manner that when the exterior case is closed, the watch has the appearance of an ordinary open-face watch, or an ordinary hunting watch."

The inner case has a solid back, and the dial covered with glass. The middle part of the outer case has hinged to it a back on one side and an open ring on the other. The pin on which the open ring turns, is not opposite to the ring or pendant of the outer

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case, but is at an angle of 45° to a line passing through the ring and the centre of the watch. The stud for the pivot is also capable of moving on the pin of this hinge, and the line joining the axis of the pivot and the winder cuts the line joining the 12 and 6 hour-marks exactly at angles of 45°. Therefore by opening the outer back and open ring, and turning the inner case on its pivot, the 12 or 3 o'clock mark may be brought under the pendant, and the instrument closed up as an opened faced or hunter watch. Some of these cases were most exquisitely engine turned.

CHARLES FRODSHAM, *Strand*, was a juror, and of course excluded from award. His display consisted of *clocks;* astronomical both for mean time and sidereal time; specimens of portable regulators; carriage clocks with compensation balances and chronometer escapements; also some with levers and chronometer escapements; and small chime clocks;—of *Watches*: repeaters, stop-split centre seconds and other timing and stop watches; also specimens of new movements; —of *Chronometers*, two-day and eight-day for marine purposes, and one going a month; an eight-day and a small two-day drawn to new and defined proportions; also pocket chronometers;—of Inventions as *Models*; a new double compensation balance; a new compensation micrometric balance; a differential compensation balance; likewise a new balance spring called the "Duo in Uno," for perfecting the adjustments of high class watches and chronometers in various positions.

Mr. Frodsham's painstaking display, brought before the public his suggestions for a new system of measurements, and his tables for intercomparison with foreign measures. An excellent testimony to the feeling of an artist and a sound practical man, was afforded by the Juror's choice of Mr. Frodsham to draw up the report for Class XV.

Messrs. E. & C. GUILLAUME, *Myddelton Sq.*, had contrived that each article in their small case should represent some distinct feature in the horological art. Thus there were two lever watches illustrating two recent inventions for avoiding the acceleration upon time caused by an undue impetus communicated to the balance by external motion. One is Mr. Cole's resilient lever, which escapement has not yet we think been sufficiently tested and appreciated, on account of the accuracy required in its construction. The other invention is Guye's patent, in which the lever-notch is formed by two fine gold springs, which yield to the impulse pin when it has been carried over the second turn by excess of motion in the balance; but the springs form a solid notch by resting against the sides of the lever when acted upon in the regular way.

In more complex watches, there was an independant-seconds watch, having the position of the trains reversed, thereby gaining proper room for the escapement; a repeater having a crystal dial to display the mechanism, and a keyless independant centre-seconds minute repeater, which was acknowledged to be a masterpiece of simplicity and beauty of calliper.

In the construction of callipers for independant-seconds and repeaters, the aim has been to waste no room, to lose no power, and to preserve those proportions which are now acknowledged to be the best for accurate time keeping.

J. SMITH & SONS, *St. John's Square*, exhibited a large assortment of clocks for buildings, turrets, shops, offices, drawing rooms, halls, bed rooms, kitchens, and schools, principally eight-day performers in a variety of framings and mounts, some as "skeletons," and a fine looking regulator in a well got up mahogany case, intended for a gentleman's hall. We notice more in detail his turret-clock tower and summer-house, with eight-day striking clock having four faces each 3ft. 6in. diameter, intended for illuminating. The clock is constructed on the repeating principle, has maintaining power to keep it going while winding, and inside dial-plate by which to set the four pairs of outside hands.

The clock tower is surrounded by seats and bronze rail, and surmounts the summer house which has appendages, suitable for flowers, &c. The intention of the whole arrangement is to supercede the old custom of placing a clock over stables, by rendering it an ornament to the park, lawn, or garden.

Another superior turret clock was shown, similar to one constructed for the South Kensington Museum by these makers. The wheels and bosses for the pivots are of gun metal, the pinions of steel. The frames are of iron and so constructed that any part can be removed for cleaning without disturbing the remaining parts. The escapement is on the principle of Graham's dead-beat, and the steel pallets are made to slide in turned grooves, so as to set the pitch exactly, and being secured by screws can be removed when required.

The striking apparatus is on the repeating principle, which prevents the possibility of striking wrong hours, which sometimes happens with clocks having locking plates. The maintaining power, to keep the clock going while winding, is the well-known bolt

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and shutter. There is a small dial to set the hands by. The pendulum has a heavy spherical ball, and the rod is of prepared pine secured against atmospheric action by being coated with varnish and French polished. The pendulum is set in beat by a traversing screw, and the crutch has also two large screws to regulate and reduce its friction.

We will not omit to mention an illuminated dial for public buildings, the numerals, minute stops and mouldings being of copper, and glazed with opal glass.

Lastly, although not horological we will not over-look, (it tending to show into what bye-ways the horological trades may wander) a revolving machine, consisting of strong spring movement in a mahogany box, with circular plate, for the exhibition of figures in shop windows.

W. HISLOP, *St. John's Street Road*, showed a standard, or observatory clock, showing mean and sidereal time. This arrangement consists of a train of wheels for sidereal time driven by the ordinary train for mean time, the sidereal time being shown on a supplementary dial. It prevents the necessity of reducing by calculation the mean time to sidereal time or vice versa. In observatories two clocks are generally required otherwise the problem of finding sidereal time must occasion continual calculation. This combined clock therefore will answer all the purposes required of a sidereal timepiece, be more convenient, and save expense. At the Exhibition under disadvantageous circumstances it performed well. It will perfectly answer as a standard regulator. The wheel-work can be applied to show both times on a single dial, and the supplementary dial, can be applied to any clock.

WILLIAM MORRIS, *Blackheath*, displayed an electric regulator and electric clocks. He claims the following advantages for them:

Firstly, Simplicity being entirely without detent, locking, or adjustment of any kind; the weight which gives impulse to the pendulum being kept in its place by the magnet instead of a detent or locking, as was generally the case.

Secondly, Cheapness, consequent on dispensing with the locking and being able to use much smaller magnets.

Thirdly, Gravity escapement wholly without friction, as the weight giving impulse to the pendulum describes the same arc as that part of the pendulum on which it presses. The pendulum is independant of the train, and is not at all affected by the varying power of the battery.

JOSEPH LOSADA, *Regent St.*, made a rich and brilliant display. Nearly all his watches were in gold hunting-cases, mostly highly ornamented, of the lever, duplex, and pocket chronometer construction, with minor variations, as keyless, centre-seconds, repeaters, and differences in jewelling. Two hunting clock watches constructed to strike the hours and quarters, to repeat them every quarter of an hour and at pleasure, one showing the days of week and month likewise. For marine purposes he displayed a binnacle clock with lantern and reflector, and a cabin dial in mahogany case, both having lever escapements, and said to be compensated and adjusted; also an eight-day and a two-day chronometer, of the ordinary construction. His clocks were well mounted, "skeleton," "chiming," and "musical," the latter strikes the hours on a deep gong, the quarters on eight bells, and plays one of four overtures at each of the hours.

EDWARD WHITE, *Pall Mall*—We have already given this exhibitor credit for his splendid display of clock cases; the Gothic eight-day clock we deemed the finest design. It strikes the hours on spring bells, the quarters on four bells, and is mounted in a richly carved oak case, with columns, roof, crockets, finials, crestings, and panels in polished brass. There were eight other elaborately got up portable clocks. All his watches were in gold hunting-cases, being a variety of 18 keyless, and 12 winding with a key. The chains, lockets and other pendants were in good taste. The dials and cases were of different patterns and variously engraved. There was a pocket chronometer with two dials, one showing English the other Turkish time, Some watches were set with diamonds and enamelled, they included half-quarter, quarter, and minute repeaters, a "blind man's watch," and an open face observation watch to register the commencement and termination of an observation without stopping the watch. He had three specimens of eight-day chronometers, and two of the two-day, one with an auxiliary compensation; otherwise they differed merely in size and mounting.

A monthly astronomical clock, with mercurial pendulum, and pallets jewelled with sapphires, attracted much notice, but the merit of this piece could evidently only be determined by a careful trial.

(To be Continued.)

SWISS HOROLOGY,

At the International Exhibition, 1862.

The Swiss, our formidable competitors, did not muster in such strength as might have been expected, a fact which can be accounted for, not only by the difficulties arising from

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the distance, and the more limited means at their command; but also by the short time allowed them to get their goods ready; their commissioners having fixed a certain day in February as the last on which articles could be received. Still we had a sufficient display, and sufficient variety to help us to form an idea, not only of what they *do* manufacture for commerce, but also of what they *can* do, and what they *aim at* in instruments of precision. At the same time we must not hastily pass a judgment upon productions so different from our own, and an ingenuity so distinct from ours in its characteristics.

If we study the productions of those Swiss watchmakers who work "con amore," who are not eager for commercial success only, but delight in scientific pursuits, we find that they have followed a line of their own, and that although they acknowledge the greatness, and perhaps the superiority of our great horologists, yet they, the Swiss, have preserved their independance of thought, and have endeavoured to follow out the suggestions of their own minds.

The imitations of English work, complained of in this country, come from the commercial portion of the trade; and no more invalidate the orginality of Swiss conception, then Birmingham copies make us forgetful of the real merits of our *bonâ fide* artists.

Since 1851 the Swiss, we find, have been *moving* too. The first Exhibition spread their fame as the cheapest producers of ordinary watches, and as the most skilful decorators of ladies' watches; proving that they excelled in the two features which would ensure an extensive market. They have not made much advance in the same direction, which perhaps would have been difficult, but they now direct their attention also to the production of the best class of watches and chronometers; and as their fame is not great yet in that line they come backed by "ratings, (bulletins de marche) from the cantonal observatories of Neuchatel and Geneva; and we must say that they show very creditable results. Still, as the prices of articles of this class are equally as high as those of the best English watches, the competition cannot be serious for some time to come; and we must not lose sight of the fact that we have every opportunity and facility for progression also. That we are not idle is proved by the present display in the British section.

Some of our contemporaries have taunted English horologists for not adopting machinery as their principal auxiliary; but let us tell them once for all; firstly, that the Swiss do not owe their success to machinery, such as is understood by our patronizing friends; secondly, that watches cannot be treated like pins, nails, or stockings; and thirdly, that machinery such as is adapted to our delicate work has received a great developement in the shape of tools of every degree of complexity, and every variety of use.

To return to the Swiss Exhibition, several features characterized it;—such as the use of the cylinder escapement for cheap watches; the preference for the straight line lever for good work, and the pivoted detent instead of the spring one for chronometers. We noticed also the great number of "tourbillon" or revolving escapement watches exhibited, and no two being quite similar. The Swiss seem to attempt that beautiful but unnecessarily complicated escapement whenever they want to show by a "tour de force" what they can do. A competent workman could not easily make one in less than six weeks.

We will now notice the cases of the principal exhibitors; but wishing to avoid a classification based upon the order of merit, we propose to take the topography of their court as our arrangement. Beginning in the nave we first faced the Geneva display, and taking the extreme left we found the case of Messrs. MOULINIEE et LEGRANDROY well stocked with the varied productions we might expect from Geneva; besides which were some enlarged models of the four escapements in general use; and also a box with artificial singing birds.

The next name was from Neuchatel, Mr. C. H. GROSCLAUDE, of Fleurier, exhibiting a surprising stock of watches and repeaters, keyless, reversible, &c; and a marine chronometer, all of which are manufactured with care and intelligence. Several of these watches are in the ornamented and rather heavy style required for the markets of Spain and central America.

Speaking of Fleurier, we regret that we had here no specimens of the highly decorated and beautiful watches manufactured in that locality for China by another well known house.

Mr. L. AUDEMARS, of *La Vallee*, has been one of the successful exhibitors, and seems to have deserved it by the ingenuity and skill lavished upon the beautiful and complicated works he displayed; from a little toy representing a pistol about two eighths of an inch in length, and which can be fired, to the most intricate combinations of repeaters and astronomical watches, clock-watches, and pocket chronometers. One of those intricate repeaters is valued by the maker at £280.

Mr. GOLAY LERESCHE, of *Geneva*, exhibited principally ladies' watches, tastefully

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ornamented; and a mechanical case with chronometer, thermometer, and aneroid, tastefully got up.

Messrs. LANG & PADOUX, also from *Geneva*, had a beautiful display of watches, pocket chronometers, with certificates from the Geneva Observatory, and ladies' watches decorated with wonderful taste; some enamel paintings are most exquisite gems.

Messrs. ROSSEL & SON'S case contained watches, and a great deal of stylish jewellery, besides some singing birds. During the days of sale their stall was literally besieged.

Messrs. AUBERT & LINTON, who exhibited in the British section also, had here a very creditable display; but their great hit was the now far-famed piping bull-finch, a happy introduction of a well known kind of automaton, and still happier thought of making its talent co-operate in the relief of the distress in Lancashire.

The case of Messrs. BAUME & LEZARD, wholesale dealers, contained as might have been expected, excellent samples of good and sound watches, at moderate prices; as well as the more showy ladies' watches, and several repeaters. A pocket chronometer, the performance of which was tested by the chief astronomer in Geneva, seems to have given a remarkably good result.

Passing on towards the inside of the court, we came to a wonderful specimen of ingenuity and patience, Mr. GRETILLAT'S clock. This gentleman, a native of the Canton of Neuchatel, has met with great encouragement from the French government, under whose liberal patronage he was enabled to produce several works of merit; one of which, a marine chronometer having a weight for its motive power, was detained in Paris, and could not be exhibited here. The clock could not be properly described in this short review, but suffice it to say that it is astronomical and geographical, and gives the time of 23 meridians. A thermometer finds room in the bob of the pendulum. The special commission appointed in Paris to report on the chronometrical properties of this clock, valued it at £4000. It occupied the inventor 23 years to make.

The next counter was the one allotted to the exhibitors of tools; and here, however scanty the display, considering what it might have been, we certainly are of opinion that our advisers and prompters, on the one hand, will see that something has been already done in our trade in the application of machinery, and on the other hand, that our old fogies and those who work with a "nail and a piece of cork" will have learnt that what is required is first to make use of what is already invented in the way of tools for facilitating production.

Mr. EHNHUUS, showed a fine array of tools of every description, but principally of the more complex order.

Messrs. KEIGEL & BOREL had a small case of excellent tools, adapted especially for watch repairing.

The well-known firm Messrs MÜLLER BROTHERS, of *Dean St* and *Geneva* exhibited besides watches and musical boxes, a great variety of tools, from the simple brush, to the three-pointed instrument for testing and planting lever escapements. Messrs Müller have also introduced a gauge based upon the English standard inch, but divided decimally and delicate enough to register the two-thousandth part of an inch. We feel pleasure in recording the gift of this model gauge by Mr. Müller to the Council of the Institute.

We next saw some main springs by Messrs RAYMOND and ROUMIEUX; and a large assortment of watch-movements from the factory of Mr. P. E JACCOTTET; these movements seem to be of a tolerable quality, considering that some of them can be sold, with the wheels pivoted and planted, for nine francs.

Messrs. BOURGEAUX and DELAMURE showed some good screw plates and screws, articles the sale of which has increased very much in this country lately, the Swiss plates and screws having generally a finer and better tap than ours.

Swiss files have had the same success, and here we saw specimens of them of every conceivable shape in the case of Messrs BAUMEL & SON, and in that of Mr. VAUTIER.

Much has been said of late about the shape of teeth for wheels and pinions; and it seems somewhat agreed that they must be epicycloidal. Mr. INGOLD of Chaux de Fonds exhibited files for "rectifying" the teeth of wheels, that is, giving them, (after they have been cut by an ordinary engine), the epicycloidal shape. It has been ascertained that watches, the trains of which have been rectified in this way, after they had been going, crossed better than they did previous to the correction.

By a sudden transition, our next move brought us to the counter devoted to Neuchatel exhibitors, where the masterly engravings of DUBOIS and of KUNDERT first met our view. The works of these two artists are universally acknowledged to be of the highest artistic merit. Mr. DUBOIS, besides a good variety of handsomely decorated watch cases, gave us some gorgeous illustrations of his artistic rendering of animate subjects and allegorical themes. A combination of the

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two styles was shown in his "four quarters of the world," and his Landseer-like skill peered through many smaller contributions. Mr. KUNDERT is a pupil of the veteran Mr. Dubois, and worthily emulates his teacher, next to whom he ranks in merit. This artist seems to revel in landscapes. What more delicate in finish and true in treatment, than that beautiful "beech," (not an oak as some reviewers have termed it.) No wonder that the Society of Arts have secured this gem. The "Madonna della Sedia," is a master-piece of expression.

When studying those two artists we could not prevent our thoughts reverting to the detractions and revilings cast upon the taste of the age, by unpractical teachers of ethics, or discontented imitators. Who can accuse the two distinguished artists just noticed, of want of taste or lack of relish for high art; and yet what do we find? They do not throw away their most accomplished productions by exposing them on the back of a case, to be disfigured and rubbed out, they carefully display them on a gold plate, to be looked at, like a picture. And what do they give us on watches? At the most a simple hunting subject, but more likely to be some tasteful "geometrical pattern," with deep cuts, and bright cuts, and all the rest of those "incongruous conventionalites," as some term them. Beauty is only to be found in truth; and as pictures are not intended to be hung in one's pocket, let us have for watches a mere ornamentation, ranging from the engine-turning, (the alpha of geometrical pattern,) to the rich combinations of beautiful lines and symbolical representations.

Before dismissing this ornamental branch of our trade we have yet to mention another very good engraver, Mr. GRANDJEAN, who however principally excels in letter engraving, in illustration of which he exhibited a fine composition. Proceeding on our journey round the counter, we came again to watchmakers proper, and here we greeted some of the most scientific and careful horologists from Locle. We at once perceived a style differing widely from the one studied by the Geneva manufacturers, who now aim principally, though not exclusively, at external attractiveness, whilst here the time-keeping properties are the chief object.

The first name we met was that of Mr. SYLVAIN MAIRET the Swiss juror, whose knowledge and experience justified the honor conferred upon him by the Swiss authorities. An inspection of the works here exhibited will satisfy a "connaisseur" that, to a thorough knowledge of the theoretical part of the business, is added a great ingenuity in its application, and a remarkable care in the manipulation and the finish of the work. Mr. Mairet appears to be equally successful in all his attempts; whether the plain pocket chronometer, or the combinations of repeaters, or the Lilliputian watches. Of these last he had several of the size of a shilling, and one not larger than a four-penny piece; and perfectly correct withal. In full sized watches the samples were also excellent, some with fusees, others with going barrels. We noticed a pocket chronometer repeater, with fusee, reversed calliper, no top plate, but a neat cock bridging over the fusee and wheels, the barrel being merely secured firmly at the back of the pillar plate by its own arbor. This watch has the addition of a metal compound bar thermometer. Mr. Mairet also exhibited a keyless clock-watch, with minute repeater, chronometer escapement, and having a crystal dial to show the work. We must not omit noticing that the winding in pendant here used, and now generally adopted for watches having two barrels, was invented by Mr. Mairet so early as 1850. The barrels wind up in opposite directions, and being supplied with proper contrivances of click-work &c., one barrel can still be wound after the other one has stopped.

The next case was that of Mr. MULLERTZ, of Locle, whose productions seemed to be of a very good quality. He exhibited marine pocket chronometers. Our attention was arrested by a curiously contrived winding mechanism, applied to fusee watches.

Mr. NARDIN, also of *Locle*, came forward with a fair display of first class watches, many of which show by their stout proportions that they are intended for those regions of South America, where they still retain the Spanish adage that "watches and cheese are bought by weight,"

Relojes y queso
Se compran al peso.

He had not however these dumpty specimens only, but a variety of beautiful watches, carefully manufactured, and independant seconds watches registering the fifth of a second.

Several of the Swiss manufacturers have the jewel holes set in gold, which gives a novel appearance, and does not tarnish so soon as brass. They also use nickel movements very extensively on account of the hardness of that metal. The principal disadvantage of it is that the colour cannot be revived by simply brushing or washing, like a gilding. Wheels are sometimes also made of nickel, and some of gold, as being harder, and having a finer grain than brass.

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Messrs. MONTANDON, FRERES, of *Locle*, had a very creditable show and great variety, very pretty ladies' watches, reversible cases, "tourbillon" escapements, an independant seconds watch giving both the dead second and the fifth of a second, and registering either. A pocket chronometer, rated at Neuchatel, has performed admirably.

Mr. PERREGAUX exhibited some small marine chronometers. We understand that Mr. Perregaux is also the inventor of a "thermometric watch" (not a watch with a thermometer,) which has given remarkable results. An account of it is given in the annual report of the "*Societè des Sciences Naturelles*" of Neuchatel. We may perhaps be enabled to describe it at a future time.

Among the principal exhibitors are Messrs. H. GRANDJEAN & Co., of *Locle*, who have already been noticed in the Journal, as having brought from the observatory at Neuchatel two marine chronometers which served to ascertain the longitude of Neuchatel, relatively to Greenwich. This firm also exhibited first class watches, with very satisfactory tables of rates. One of our eminent English horologists, in a speech delivered at the annual dinner of the Institute, stated that the Swiss watchmakers owed part of their success to their enterprise in going to distant countries as traders and merchants; which statement certainly applies to the head of this firm, among many others of like energy.

Our limited space does not permit us to give at great length the result of our examination of the different displays, and we must hasten to notice yet a few good exhibitors.

Messrs. PIGUET, FRERES of *La Vallèe*, had a case of repeating movements, and keyless work, (in the grey, and not cased), which deserve notice for their good quality.

Messrs. BOREL & COURVOISIER, of Neuchatel, displayed a good variety of articles.

Mr. ALF. COURVOISIER, of *Chaux-de-Fouds*, showed some chronometric specimens;—independant seconds, keyless, "tourbillon," &c. which were as might be expected from that conscientious horologist most carefully manufactured.

Mr. ALB. JOHANN, of *Chaux-de-Fonds*, startled us by the rich effect given to his pocket chronometers, by cutting and piercing the top plates in the shape of regal crowns, adorned with diamonds or merely enamelled.

We next inspected an ingenious contrivance by Messrs SANDOZ FRERES, of *Les Ponts*, to get a dead second on the dial. It is an old contrivance, consisting of a lever-locking, a split pointed tooth, and five pins or upright cogs, to give impulse to the balance, with a fourteen thousand four hundred train. The Swiss it appears have not left their inventive faculties dormant, and although they have not perhaps produced any thing equal to the resilent lever, nor attempted the correction of the compensation balance, still it is interesting to notice a new escapement, a kind of lever which the inventor, Mr. A. S. JEANRENAUD, of Travers, calls lever "d'entretien;" (meaning, we suppose, constant force). It is somewhat similar to the one just described, with this difference that the pallets are not simply used for locking, but receive an impulse on a short plane.

When we came to the next case we thought some mistake had been made, as we could only see large bouquets of artificial flowers. We soon perceived, however, a miniature watch peeping between rose leaves. The exhibitor was Mr. OLIVIER MATTHEY, well known in Switzerland as a chemist, and who has benefited our trade by the discovery of several alloys, some of which are excellent for polishing steel. Another article exhibited by the same gentleman is an electric clock.

We must not omit to speak of the jewel holes, rollers, pallets, &c. of Mr. G. H. JEANRENAUD, of Fleurier, as the workmanship merited our warmest commendation. A specimen of skill was given in a hollow pinion of 6, in ruby, to show what the exhibitor can make out of such a hard, brittle, and intractable substance.

Lastly, we have to notice the very creditable products of the workman's association, (*Association Ouvriere*) which range from watches at 2*l.* 10*s.* to a fine timekeeper with the again recurring "tourbillon escapement," which watch is ticketed at 65*l.*

With this case we take our leave of the Swiss horologists, regretting that our limits preclude us from giving a more complete review of their interesting works; and trusting that if omissions or mistakes have occurred in this notice, our friends will understand that such errors are involuntary, and that we have laboured most carefully and conscientiously.

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ELECTRICITY OF THE ATMOSPHERE,

(Continued from page 35.)

The simplest instrument for ascertaining at any time the electric condition of the atmosphere is an electroscope composed of two equal pieces of gold-leaf, suspended from a brass support, and insulated, as well as protected from the movement of the air, by a glass covering. The cap of the brass support is fitted for the reception, in the vertical direction, of a metallic rod not less than two or three feet in length. The top of tho rod carries a clip. The instrument acts on the law that bodies similarily electrified repeal each other, but when dissimilarly electrified, they attract each other. To make an observation, the instrument is placed in the open air. A lighted cigar, fusee, or piece of touch paper, is fixed in the clip. The electricity of the air is collected by the flame, and conducted by the rod to the gold-leaf, and the pieces separate more or less according to the amount of electricity present. The kind is determined by the effect of either a stick of excited sealing-wax or rod of glass upon the electrified gold-leaf. A rod of glass when rubbed briskly with a silk handkerchief or piece of woollen cloth, becomes positively electrified. A stick of sealing-wax similarly treated acquires the negative state. If, therefore, an excited glass rod be presented to the cup of the instrument and the pieces of gold-leaf diverge still further, the electrical state of the air must be analogous to that of the glass, that is *positive*; if they approach it is *negative*. On the contrary, if a stick of sealing-wax be used, the pieces will be repelled more apart if they have acquired negative electricity from the air, and they will couverge if they have a positive charge. By means of this very simple apparatus, meteorological observers can readily ascertain the electrical condition of the lower air at any time. At most observatories the apparatus for atmospheric electricity, depending upon similar principles, are made self recording by the aid of horological machinery and photographic action upon chemically prepared registration forms. At the Kew Observatory, belonging to the British Association for the advancement of science, the arrangements are most elaborate, and the most recently improved in method and details. To attempt the explanation of the electrical apparatus without the aid of expensive drawings, would fail to convey the adequate information which nothing short of an actual inspection with due explanation, at the observatory, could impress upon the mind. Self registering mechanism has been, and is most likely to be, of the greatest advantage to the advancement of our knowledge of atmospheric electricity.

The celebrated electrician, the late Mr. A. Crosse, had several miles of wire, well insulated and connected with numerous metallic conductors, raised on tall masts, extending over his seat, near Faunton, Somersetshire. The whole of the electricity thus collected from the air, was conducted into a discharging apparatus fitted up in his labaratory, a large metallic ball of which bore the words "Nolli me tangere," be unwilling to touch me, and well might this advise be given for often the accumulation of electricity was highly dangerous to the inexperienced.

These various kinds of exploring apparatus have furnished observations sufficient to establish certain fundamental general facts. These we will now mention. The *general* electrical condition of the atmosphere is *positive*, in relation to the surface of the earth and ocean, becoming more and more positive as the altitude increases. When the sky is overcast, and the clouds are moving in different directions, it is subject to great and sudden variations, changing rapidly from positive to negative, and the reverse. During fog, rain, hail, sleet, snow, and thunder-storms, the electrical state of the air undergoes many variations. The intensity of the electricity in the air, increases with hot weather following a series of wet days, or with wet weather coming after a continuance of dry days. The atmospheric electricity, in fact, seems to depend for its intensity and kind upon the direction and character of the prevailing wind, under ordinary circumstances. It has an annual and a diurnal variation. There is a greater diurnal range of tension in winter than in summer. By comparing observations from month to month a gradual increase of tension is perceived from July to February, and a decrease from February to July. The intensity seems to vary with the temperature. The diurnal variation exhibit two periods of greatest and two of least intensity. In summer the *maxima* occur about 10, A.M., and 10, P.M.; the *minima* about 2, A.M., and noon. In winter the *maxima* take place near near 10, A.M., and 8, P.M.; the *minima* near 4, A.M., and 4, P.M.

(To be continued.)

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., NOVEMBER, 1862.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	29·924	50 6	50·2	53	48	ESE	1	m	f, mo
2	29·968	52	50 5	53	49·5	N	1	om	f, m
3	30·115	52	51	53·5	49·5	W	1	f	f, o, b
4	30 065	49	48	55	43	SE	1	f	o, bm, r
5	30·100	48·8	48 2	55	46	N	2	r	rr, b
6	30·156	42	41·5	48·5	37	Calm	0	ff	f, rr
7	30·257	42·7	42	44	38	NE	2	o	om
8	30·363	34	33	42	31	NW	2	mo	f, o, bm
9	29·770	50	48	50	34	SW	5	r	rq, bc
10	29·392	46	43	53	42	WNW	5	o	p, b
11	29·495	36·5	35	46	32	W	2	f	m, b
12	29·951	34	32·5	40	31	N	1	m	f, b
13	30·151	31	30	41	29	Calm	0	ff	ff
14	29·947	32·5	31	32·5	28	NE	1	f	f, cm
15	30·080	39	37·7	39	32	NNE	1	cm	om. r, b
16	30·193	41·5	40	44	36 5	NW	5	bm	bm
17	30·396	39	37	45	36·5	N	4	b	bcm
18	30·381	38	36·5	45	35	NNE	3	cm	omrb
19	30·208	42	40·2	43·5	35·5	N	4	o	r, m
20	30·221	39·5	37	41	34	NE	2	bm	om
21	30·203	39	37	40	36	NE	1	f	mf
22	29·974	37	36	41	32	N	2	m	m, b
23	29·778	29	—	39	28	Calm	0	f	f, b
24	29·788	34	32	37	29	N	2	m	cm, b
25	29·740	36	34·2	40	31	NE	3	cb	c
26	29·560	40	39	40	34	N	2	om	o, r, f
27	29·488	41	40	41	35	WNW	2	f	o, b, r
28	29·801	41·5	41	46	36	SE	1	m	om
29	29·685	42·2	41	49	39	ESE	2	o	o, m
30	29·842	40	39	42	35·5	Calm	0	ff	f, m, b, r
	29·966	40·7	39·4	44·7	36·2		2	Mean.	

REMARKS.

The highest observed pressure was 30·42, at 11½ p.m. 17th; the lowest, 29·39 near 9 a.m. 10th; hence the range of barometer was 1·03 inches.

On the 9th the wind blew very strongly from S to W, otherwise this locality has not experienced any gales this November, although the barometer has fluctuated very much. It may be that severe gales have occurred southward of London, sweeping over the continent, and that our polar winds have formed their northern outskirts.

There was a scarcity of rain; it fell only on 10 days, during about 53 hours, to the amount of 1·12 inches.

Fog and mist were very prevalent. Decided fog was estimated to have prevailed during at least 100 hours altogether.

Frost was seen on the ground on 14 nights.

The wind blew from the N on 13 days; E, 6; S, 2; W, 5; and it was calm 4 days, according to the 9 a.m. observations.

ALUMINIUM BRONZE.

At the last meeting of the Council of the British Horological Institute, Mr. Hislop exhibited some specimens of ten per cent. aluminium bronze, with the view of showing its qualities in relation to oxidation or tarnishing. It has been stated that it scarcely tarnishes at all in ordinary atmospheres, and if it does, it does so slowly. The specimens shown, had been polished but a few hours, but they exhibited very decided marks of tarnishing, although only exposed to the ordinary atmosphere of a town. The actual amount of oxidation was considerably more than would have been shown by hard rolled or hammered brass in the same period of time. The use of this compound metal has been recommended for the fine work of watches and chronometers, as not requiring gilding because it does not tarnish, but the facts do not appear to be exactly in accordance with what has been stated.

Moreover, if the metal tarnishes so readily, what would be the probable effect of the oil applied for lubrication of the surfaces? Further experiment is required in this direction and if our readers feel disposed to try it they may obtain any quantity of the metal of Messrs. Bell Brothers of Newcastle, and can get it rolled at Messrs Buckland & Sons, Hop Gardens, St. Martin's Lane, London.

TO CORRESPONDENTS, &c.

J. SPRATT.—The diamond is capable of dividing the surface of the hardest steel. It will burnish steel if a proper surface of diamond could be prepared, as this is difficult, it is a very inappropriate material for the purpose. Further, it will not polish steel better than other materials, in fact it is quite an improper substance to employ for polishing steel. You say, "given hard tempered steel wire, similar to pinion wire, would it be most advisable to have the diamond as a rotating cutter, fixed on a revolving wheel, or with a reciprocating movement." This question cannot be answered without a more explicit statement of what is required to be done. Either way might be used, according to requirements. Diamond dust is readily obtainable, but it is necessary to separate it into various degrees of fineness, before it can be advantageously employed. This every artist does for himself.

J. L. TILLING.—Your communication must stand over, until some other replies to Mr. Johnson's letter are received.

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SEQUELIN'S

WATCH AND CHRONOMETER OIL.

TESTIMONIALS.

Royal Patent Floating Compass Manufactory, 25 & 26, Strand-street, Liverpool, Jan. 25, 1862.

I have used Mr. S. Sequelin's Watch Oil, and found it superior to all Oils for Watches I ever used.

C. J. GRAY.

Chronometer Manufacturer to the Queen of England, the Emperors of France and Russia, the King of Prussia, and the United States' Navy.

3, St. George's Crescent, Liverpool, March 7th, 1862.

We have tested Mr. S. Sequelin's Watch Oil, and found it good, and use it in preference to any other.

JOSEPH PENLINGTON.

7, South Castle-strcet, Liverpool, 12th August, 1862.

I have used Mr. Sequelin's Oil for the last Ten months, and have found it superior to any other.

JOHN CAMPBELL.

15, Market-place, Hull, 15th August, 1862.

Mr. S. Sequelin: Sir,—Our Watchmaker has tried your Oil and approves of it. We are, your's respectfully,

BAMBY & RUST.

Notice:—None genuine unless sealed with the name of the Inventor, S. SEQUELIN, and each label endorsed with his signature.

Sold Wholesale only by the Inventor, S. SEQUELIN, 20, Pine Street, Liverpool.
Retail by CHRISTOPHER ROWSON, 44, Sir Thomas's Buildings, Liverpool.

And at the various TOOL SHOPS in the UNITED KINGDOM, AMERICA, FRANCE, & SWITZERLAND.
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CLOCK OIL ONE SHILLING PER BOTTLE.

Sole Agent for London—Mr. E. LEE, 35, Northampton Square, E.C.

Prize Medal, London, 1862.

For General Excellence.

To the Honourable
THE BOARD OF ADMIRALTY.

V. KULLBERG,

12, CLOUDESLEY TERRACE,
Liverpool Road, London, N.

Prize Medal, Besançon, 1860

For Chronometers and Watches

MANUFACTURER OF MARINE AND POCKET CHRONOMETERS

AND OF IMPROVED KEYLESS FUSEE WATCHES,

CHRONOMETERS WITH IMPROVED COMPENSATION BALANCES FOR EXTREMES OF TEMPERATURE.

N.B.—Two Chronometers with KULLBERG's New Balances, stand First in order of merit on the Annual Competitive Trial, at the Royal Observatory Greenwich, just completed.

The *Daily Telegraph* in its Article on Horology in the International Exhibition, says, "Looking to Chronometer Workmanship, we find the best Case of Specimens in the building, without an approach to rivalry to be that which is shown by Mr. KULLBERG. We speak more particularly with reference to Ship Chronometers though the same Exhibitor has examples of most other kinds."

PRINTED BY P. MACDONALD, STEAM PRINTING WORKS, 61, ST. JOHN'S SQUARE, E.C.

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THE BRITISH HOROLOGICAL INSTITUTE.

HALF-YEARLY GENERAL MEETING.

PURSUANT to notice, the Half-yearly Meeting of the Members of the Institute, was held at the rooms of the Institute, on Tuesday, December 30th, for the purpose of receiving a Report from the Council of the state of the Society during the past half-year, and also to fill up three vacancies caused by the resignation of officers.

In the absence of the President, Mr. GEORGE BLACKIE was voted to the chair. The CHAIRMAN opened the proceedings by calling for the names of gentlemen to act as scrutineers.

Mr. HUX rose to object to the election as being illegal, on the ground that there were thirteen vacancies, while it was proposed to fill up only three. He thought it was desirable for the interests of the Institute that the names of the members who did not attend should be known; and he remarked that they already had one Vice-President who had not attended since the last election, and it seemed to be thought very desirable by some persons that another gentleman should be elected as Vice-President for the same reason He should move—That the election stand adjourned for two months, to enable the members to fill up the whole of the vacancies on the council.

Mr. BROOKS seconded the motion. He considered that publishing the names of persons as members of the council when they were not so, was a fraud. The laws provided that there should be 28 members of council, when in reality there were but about half that number, and under these circumstances he did not feel justified in letting his name stand on the balloting list, and should therefore withdraw.

The Honorary Secretary stated that it was not the fact that there were 13 vacancies. Three gentlemen had resigned, and the council were bound to fill up the vacancies so caused. The laws gave the option to the council of removing the name of a non-attendant from the list of officers; but it would be easily understood that a rigid carrying out of this law would be prejudicial to the interests of the Institute. It had therefore never been fully carried out. Some names had been mentioned to swell the number of absentees that could be proved to have attended, while others did duty on the sub-committees, on which bodies the real work must always devolve. Taking, therefore, even the letter of the law, the council were not justified in declaring so many vacancies as had been asserted.

Mr. JOHNSON moved as an amendment—That the meeting proceed to the business for which it had been summoned.

The amendment having been seconded by Mr. JONES, was put to the meeting, and declared carried.

Messrs. VILLANUEVA and HEWARD were elected as Scrutineers by shew of hands.

Objection was taken by several members to the manner in which the ballot was proceeding. After some discussion, the Honorary Secretary pointed out that by the laws the duty of the Scrutineers was themselves to examine the right of a name to a vote, as well as subsequently to count such votes. Whatever might have been the former practice, it was clearly illegal for the Chairman to perform this duty, or for any officer of the Institute to do so. The envelopes were therefore opened by the Chairman, to whom they were directed, who ascertained if the voter's names were signed inside the envelope, and then placed them in the box. They were then handed to the Scrutineers, who in the presence of the meeting removed the whole from the balloting box, and examined the right of each name to a vote by reference to the subscription list, destroyed the envelope with the inscribed name, replaced the contained folded list of names in the box, and retired to count the votes. After this explanation, the election was allowed to proceed.

The Honorary Secretary then read the Report for the past half-year, with an audited financial statement:—

"REPORT OF THE COUNCIL, FOR THE HALF-YEAR ENDING DECEMBER, 1862.

"In accordance with the laws of the Institute, your Council present their half-yearly Report and financial statement.

"In their last Report they regretted to have to allude to the depressed condition of horology as a commercial pursuit, but they congratulated the members that the Institute had suffered but little in consequence. As is well known, the trade has not revived during the past six months; but notwithstanding this drawback your Council are happy to find that still less effect is perceptible upon the Institute than before. They have endeavoured, as far as possible, to economise the expenditure in accordance with the times; and they are able to report that the result has been, that in a financial point of view, the Institute is in a better condition than it was at the last General Meeting. This is the more gratifying, as there has been no extraordinary effort made either to increase the number of subscribers or to obtain funds; and yet they have no doubt that when the annual audit takes place in June, the Institute will be found not only free from debt, but able to speak honestly of a prospect of the accumulation of funds for the better carrying out of its objects.

"The *Horological Journal* continues to yield a profit to the funds, but the Council think that more might be done by the members. It is now laid on the tables of our principal scientific societies. It is quoted both in English and foreign journals, though sometimes without acknowledgement; and although, as a technical and essentially a class periodical its circulation must probably be somewhat limited, yet that circulation might be

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greatly increased, if the members reflected that each fresh subscriber is in fact an addition to the funds of the Institute.

"If no other object had been attained than the establishment of an *Horological Journal* in England, your Institute would not have been without a good result.

"The past half-year has been one of great interest to many of our members, in connection with the International Exhibition. Most of the exhibitors in the English department there are members of the Institute, and several others have since joined it.

"Our library and museum are gradually increasing, and your council propose to adopt measures for making the library valuable as a depository of ancient and modern books on horology. To this end they would suggest the desirability of searching for such works, and either presenting them to the Institute, or indicating where they may be obtained, so that either by gift or purchase this desirable end may be attained.

"During the last few months an Horological Society has been formed at Edinburgh, which has the best wishes of the friends of the British Horological Institute.

"Communication has been opened with the members of that society, and your Council trust that it may prove for the benefit of all concerned.

"In conclusion, your Council express an earnest hope that the coming year may bring brighter prospects for the industry of the country, and that those who follow a pursuit like horology, which demands the intense labour of both brain and hand, may reap their well deserved reward in better pecuniary returns, and in an increased demand for their productions."

Mr. JONES rose to move the adoption of the Report, and the appended financial statement. He had ascertained from an absent member that the Institution was in an independent condition, paying its way, and reducing such liabilities as are inseparable from a new enterprize. They must justly look to the profits of the Journal for means in aid of the Institute. Each member received the value of his subscription in the Journal since it supplied him with special matter which had a value for him higher than the market price of the Journal. Its circulation was now sufficient to justify us in looking for advertisements beyond the trade; local advertisements might fairly be solicited, and the trade of watchmakers was important enough to justify us in looking for advertisements from the public. If these ideas were carried out, the surplus profits of the Journal might enable the Institute at some future day to grant pecuniary rewards to meritorious inventors.

One great benefit of the Journal was that it created a public opinion in the trade. Its judgements were of value, because they were given with discrimination by men competent to form an opinion.

The object of the Institute was to diffuse such knowledge as had already been reached, and to encourage advance to higher excellence. There was a difficulty in getting men to surrender to the public, to the prejudice of themselves and families, that knowledge which had cost them much pains and time to acquire, but the Journal was a channel, through which when they had reaped all possible advantage to themselves from their discoveries, they might bequeath their ideas for the benefit of the trade.

The influence of the Institute had been successful in the display of watches at the Exhibition. He regretted that the scheme of an exposition by the Institute had been abandoned, for it would have given a presence and an authority to it which would have enabled it better to work out its purpose. Its efforts however had not been lost, for our trade took a very substantial position in the general display though it was unfortunate in its locale. The allusion in the report to the commercial condition of the trade was one of interest. Seeing that a large number of men who were connected as we were with America were in absolute want, we might be thankful that our trade only suffered depression when it might have been totally suspended. Trusting that they would consider it satisfactory to know that their income exceeded their expenditure, and that if maintained at its present standard it would enable us before next meeting to be free from debt, he moved the adoption of the report.*

Mr. E. D. JOHNSON seconded the motion, not for the purpose of making a speech, but for the purpose of correcting an error into which Mr. JONES had fallen, namely—"That it was a pity that the notion of exhibiting a case under the auspices of the Council of the Institute had fallen through." He (Mr. J.) spoke through the authority of experience, and judging from the amount of jealousy in connection with the amount of display made by the Prescot committee, he should say that a similar amount of heart-burning had never been produced in that town by any cause of like extent; therefore he (Mr. J.) rejoiced that the exhibition by the Institute had fallen through.

Mr. BROOKS had availed himself of the privilege belonging to members of looking over the Institute's books, and had there seen a statement to the effect that there was a deficiency of 3,112 *Horological Journals*, which had cost the Institute within two shillings of £39†. He should like to know something about that, as the question to some extent affected him, as he had been on the "Journal Committee;" but, when he went out of office, he had taken stock of the Journals, and would not deliver up the keys to his successor till they had been counted and stated to be right. Before sitting down, he might observe that here was a strong instance why the press should be present to give a proper statement, for it had been rumoured that there were 18,000 Journals deficient.

The Honorary Secretary stated that when he took that office eighteen months since, he found the affairs of the Institute in much confusion. He had endeavoured to get the Journal accounts

* In the midst of his speech, Mr. JONES was interrupted by Mr. HUX who rose to move that a reporter (a stranger to the Council) should be admitted. Mr. JONES protested against the irregularity of bringing forward a motion while he was in possession of the chair and was then allowed to proceed.

† The actual cost, deducting the printing of the advertisements, is under £20.

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made out, but could not succeed. He had therefore examined them himself. and had drawn up a report, which was presented to the Council and entered on the minutes, where it was seen by Mr. BROOKS. It was not for him to say on whom the responsibility of the deficiency rested; and although he had an opinion on the subject, it might be considered as a libel if he uttered it.

Mr. MYLNE, the late Honorary Secretary, said that there was a deficiency when he took office, and that the Council had made arrangements for the sale of the Journals, which were beyond his control.

Mr. HUX considered Mr. MYLNE'S explanation very unsatisfactory. Mr. HUX adverted to the fact of various blocks belonging to the Institute being missing at one time, but three had found their way back. There could be no wonder at the non-success of the Institute, when persons who were supposed to attend did not attend, and there were committees that never met; and the principal work seemed to be in reporting that somebody had taken something away, and when the Council thought the time had arrived to interfere, they then told the Committee to tell somebody to bring something back. He was sorry to see there was a decrease in the number of members, and the Institute in debt. He was also sorry that he could not speak in support of the Report, for he should have thought it was an old one, as it seemed to be the same old song over again.

The Honorary Secretary stated that he thought it to be his duty to see that the property of the Institute was intact; and having collected and examined the stock of engraved blocks, he found that several were missing. He had reported this fact a short time since, and nearly all the missing blocks had been accounted for. The Honorary Secretary also stated that the present number of members was 292, and that there were more than six new names then standing for admission.

After some further desultory remarks, the Report was adopted.

The Honorary Secretary called the attention of the Chairman to the fact that the notices of motion on the paper for alteration of laws could not be proceeded with, as there was not the prescribed number of members present.

Mr. JACKSON then moved—That Dr. CLARKE, of Finmere House, Oxon, be elected an honorary member of the Institute.

The motion having been seconded and discussed at some length was put to the meeting, and declared carried.

Mr. BROOKS, according to notice, then moved that the Council name one evening in each week for conversational meetings of the members.

The motion was seconded by Mr. MYLNE, and carried unanimously.

Mr. R. R. HUX then moved—That the Council publish in the *Horological Journal* for April, 1863, the number of members who joined the Institute during each of the following years, viz.: 1858, 1859, 1860, 1861, 1862. Also the names and addresses of the founders, life members, and all other members who joined up to 31st December, 1862, who upon the 3rd day of March, 1863, are not two months in arrear with their subscriptions.

Mr. HUX, in supporting of his motion, said Mr. HISLOP had told them that the members of the Council had made nominations, and it was open to any member to do so. It was true it was open, but when members did not know who members were, how were they to know who to nominate? If that was one of the privileges to be elected in the Council, let it be stated so, and not let it be a secret. He (Mr. HUX) believed the only way for the Institute to prosper was to throw everything open, and let the members have free intercourse with each other, which would create sympathy, and be productive of support.

Mr. GANNEY seconded the motion.

The motion was opposed by Mr. JOHNSON, and supported by Messrs. BROOKS and MYLNE.

Mr. HISLOP said that it was convenient that the names of members should be occasionally published. Those of new members appeared from time to time in the journal; and he should have recommended that a revised list be published, but that it was absolutely necessary to reduce those incidental expenses, which were too often thoughtlessly incurred. He should however be happy to support the motion on conditions that the last clause of the motion providing for the omission of those members who were two months in arrear was left out.

Mr. HUX in reply acceded to this suggestion and said that the names might be so attached to the Journal as to leave it optional as to whether they should be bound with it or not, and as to the expense, it would be but about 40*s*. If that was the only tangible objection, he (Mr. H.) would make a donation to the Institute of a couple of guineas for the purpose.

The motion was then put and carried.

The CHAIRMAN then read the Scrutineers report and declared Mr. JONES elected vice-president, and Messrs. BROOKS, FRENCH, and HASWELL, elected members of Council. Votes of thanks having been passed to the Scrutineers and to the Chairman, the meeting separated.

CRITIQUE ON CLASS 15, INTERNATIONAL EXHIBITION, 1862,

By M. BOQUILLON.

TRANSLATED FROM

Annales de Conservatoire Imperial.

To the Editor of the HOROLOGICAL JOURNAL.

Sir,—I forward for insertion a translation of an article, which has been widely circulated in France, and forwarded to me from thence, and which is worthy the attention of our members, as relating to the labours of one of their number, and being in itself interesting as a critique from a continental point of view.

I am, Sir, yours obediently,
W. HISLOP, *Hon. Sec.*

As we have before stated, our gleanings beyond the French horological productions have been of but limited extent, we shall however point out the general conditions of an English escapement which seems to be in some vogue in England, the same, with some slight differences, being shown by many exhibitors, who adopt it particularly to small turret clocks. We heard this in-

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vention attributed to Mr. J. F. Cole, whose well established reputation is a good precedent in favour of a disposition, some particulars of which we may have overlooked, whereas at the time of our so unproductive visits to the English horological department, all the specimens of that principle were in action; we shall however describe what we have seen.

The axis of the escapement wheel is in the vertical line occupied by the rod of the pendulum at rest. The escapement wheel is composed of a disc, from which radiate a certain number of arms, the face of the disc being occupied by as many pins circularly placed. Two small pendulums are suspended or otherwise arranged, one on the right and the other on the left of the large pendulum; they have the form of bent arms which receive action from the pins of the disc. On the axis of each small pendulum stands a small arm successively used as a stop to the branches of the star of the same wheel; at a convenient point of their elevation is a plane slightly inclined, upon which act the pins, and by these pins they are removed and brought by turns at proper time to the same elevation, where they are sustained alternately by a pin of the disc. These small pendulums are terminated by a projecting pin coming successively into contact with the rod of the large pendulum to give impulse to it. It is understood that when one of the small pendulums is brought to the highest point of its course, and supported there by one of the pins on the face of the disc, the other is completely disengaged.

Let us now examine the action of this escapement. The large pendulum is supposed to be arrived at the extremity of the arc traversed from right to left, and stands in contact with the small pendulum on the left, which has just been disengaged. Both, on account of their weight, begin a new oscillation from left to right, the small pendulum adding its weight to that of the large one, the speed of which is accelerated, since isolated, the small pendulum would go quicker; in this manner it follows the large pendulum rod beyond the vertical position, meeting the small pendulum on the right, which being slightly repelled disengages the wheelwork. The escapement wheel begins its action; one of its pins raising the small pendulum on the left, the impelling action of which has just been accomplished up to the point where a branch of the star again finds its support upon the arm of arrest of the small pendulum, that is, up to the point from where it first started to give the impulse to the large pendulum, which now stands at the contact of the small pendulum on the right, set at liberty by the disengagement just produced. The same conditions are reproduced but in the contrary direction, the large pendulum receiving its impulsion from the small pendulum at the right, till it meets the small pendulum on the left, which now being disengaged leaves the escapement wheel at liberty; the escapement wheel pin replaces the small pendulum on the right to its point of elevation, in order to give to the small pendulum at the left all its liberty of action and so on.

We heard some censure as regards this disposition, there being an excess of friction between the two small pendulums and the large one, this being principally the result of the three centres of action being not concentric. The inventor may answer that in the greatest number of pieces made with the greatest perfection, the crutch and the pendulum present identically the same kind of friction; the resistance at the disengagement of the wheelwork varies with the variations of the motive force; that is true again, but it is to be met with in nearly all the pieces considered excellent, and then is it not sufficient that the elevation at which that same wheelwork brings back again the small pendulums be constant, and that the weight of these pendulums present a constant excess of force capable of overcoming the greatest resistance at the disengagement, so that the large pendulum be enabled to traverse arcs constantly equal?

We must not lose sight of the fact, that the disengagement once accomplished, the pendulum properly speaking has no supplementary arc, because, whatever may be the speed it may keep, the greatest part is absorbed either by the inertia of the small pendulum just disengaged, or, and principally, by the resistance of the same in being brought higher than the point of locking where the wheelwork has reposed. Let us add to these considerations the very short time which elapses between the disengagement and the repelling action of the escapement wheel, which after subtracting from the total mass the small pendulum, the action of which ceases to be useful, leaves the large pendulum under the single action of the other small pendulum which has just been disengaged, and which action we suppose to be sufficient to effect at the end of the oscillation the disengagement of the wheelwork whatever may be the resistance of the motive force. If then as we desire to believe, but have not been able to experimentally prove, things are disposed in such manner as to diminish the supplementary arc to the extent of considering the same as practically null, and consequently to

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render constant the oscillatory arc of the large pendulum, we think that the escapement of which we are speaking resolves with a remarkable simplicity a problem of radical importance in chronometry, that of the isochronism of the pendulum, whatever may be the variations of the motive force.

We have stated Mr. J. F. Cole to be the inventor of this escapement,* but we are more positive as regards the suspension of which we are going to speak, as his name stands above the piece.

This suspension rests upon conditions exactly inverse to those which constitute the ordinary suspension called "spring suspension." In this last the pendulum is suspended at the inferior extremity of a steel blade fixed to the clock frame by its superior extremity. More frequently two blades disposed in a parallel manner are employed; it then can be said that the pendulum acts upon them by traction.

It is quite the contrary in the suspension of Mr. J. F. Cole. The two blades are fixed, each upon one of the extreme ends of a bar in which is a cleft of a certain length made on its horizontal plane, and through which bar passes the rod of the pendulum, receiving at its upper extremity the two raised ends of the two springs—these are firmly braced together on opposite sides of the same rod. Instead of acting on these blades by traction, as in the ordinary instance, the pendulum acts, so to speak, by compression, and the weight of the pendulum determines in each spring a curvature symmetrically regular when it stands at rest. In the oscillation from right to left the radius of curvature of the spring on the left becomes longer, the spring tending to make itself straighter, while the radius of curvature of the spring on the right becomes shorter as this spring bends the more, the contrary taking place in the oscillation from left to right.

We sincerely regret having heard nothing, either of the motives which induced Mr. J. F. Cole to employ this principle, or of the results he may have obtained.†

While we are on the subject of English horology, we shall briefly mention a turret clock exactly copied from the models made in the late house of Wagner, Rue de Cadran, and which is essentially composed of a horizontal frame, upon which are fixed by screws traversing their bases the bearings receiving the axis of the wheels, principally of the clockwork; from this arrangement results the double advantage that any one axis can be taken from the frame without displacing the others, because there is no enclosure of the wheel work within a frame as usual, and that the reciprocal penetration or depth of the teeth can be regulated with all possible exactitude. In these points of view we have remarked that the large English pieces are in progress, in the sense that similar bearings are placed round the frame, and give (but with more expense) the same facilities. As regards the best imitated piece, the exhibitor of which we shall not name, we were told by an English juror that in his opinion and of his colleagues the said piece had been made in Paris. We beg to be allowed to express another opinion, the execution too much neglected of that piece giving evidently to it another origin.

* See diagram and description published in Horological Journal, vol. 1, p. 152.

† It appears by these remarks, that the card fully describing this suspension by Mr. J. F. Cole, as a gravity compensation for influence of temperature on the suspension spring, for isochronism of the arcs of vibration, and for preventing axial motion of the pendulum rod, has been unobserved by the author of these well considered comments.—W. H.

THE HOROLOGICAL SECTION OF THE INTERNATIONAL EXHIBITION.

(*Continued from page* 55.)

W. H. & S. JACKSON, *Red Lion Street, Clerkenwell.* — Two novelties deserving of record were among the instruments displayed by this exhibitor. One is a day of the month watch: it has a ruby solid impulse lever escapement, and is adjustable. The other is a watch constructed to shew local and Greenwich time from one train; it has a lever escapement, with horizontal ruby pin, and the hands set independently.

Of his other watches, two had J. F. Cole's resilient pallets; one, an eight-day, having fusee, the other toothed barrel; some were specimens of keyless, and others, solid key winders. He shewed also a two-day marine, as well as a pocket chronometer, and likewise a tool (which we were sorry to see incomplete) for indicating pallet angles and arcs of lever escapements. This instrument Mr. Jackson had prepared and referred to during the discussion which followed the reading of Mr. Cole's paper at the Institute some months since. We believe it is the inventor's intention to deposit it when com-

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pleted in the Museum of the Institute, and to give a description of it in this Journal.

STRATH BROTHERS, of *Park Terrace, Camden Town*, exhibited two large models representing the principles and construction of the "detached lever," and "the horizontal" watches, with only the slight alteration of having the dials perpendicular. The trains are slow, the lever beating 60, and the horizontal 90 to the minute. The models are fully 24 inches in circumference. The escapements, being of course proportionate in size, their actions and principles are thereby simplified as far as magnitude is concerned. To the amateur in search of horological knowledge, these models must have been instructive and amusing, and very conveniently they had appended to them a short history of the inventions.

T. ARMSTRONG, *Manchester*, displayed an office timepiece and watchman's clock combined. These clocks indicate punctuality, and register the neglect of it. He also shewed improved steam, or speed, clocks for use in factories. They are for shewing whether the machinery has been worked at proper speed, and for indicating irregularity of motive power; they therefore serve to register inattention or neglect.

J. BENNETT, *Cheapside*, had on view a very good collection, comprising marine and pocket chronometers, public and household clocks, and a great variety of gold and silver watches. His show was an elegant arrangement, surmounted by a large time ball, discharged by electric current from Greenwich.

J. W. BENSON, *Ludgate Hill*, was the exhibitor of the very noticeable large turret clock in the central avenue. The specialities of this clock are, we believe, a new double star remontoire, the application of which diminishes the friction, and will allow of great motive power. The outer dial was something like 300 feet distant from the machinery. It is evident, therefore, that great motive power was necessary. It has a compensated two seconds pendulum, and the pivots work in gun metal bosses, fitted in plummer blocks. Every wheel is of gun metal; and the whole is, for so large a machine, a creditable piece of workmanship.

The clock has chimes upon five bells, which weigh five hundred weights. The weights, of about a ton, were 200 feet from the works, suspended from ropes carried over pulleys under the floor.

Mr. Benson also shewed clocks of various kinds, and gold and silver watches. The ornamentation on some of these was very fine, Mr. Benson having, we understand, obtained designs from some of the art teachers of South Kensington Museum, and he certainly had entrusted the execution to some of the ablest decorators and engravers.

B. MARRIOTT, *Islington*, exhibited many well made watches of various descriptions, and good samples of chains and appendages.

PARKINSON & FRODSHAM, *City*, were exhibitors of watches and chronometers, which well sustained their reputation.

T. HAYES, *Appleton, Lancashire*, was an exhibitor of pinion wire in steel and brass, and samples of toothed wheels.

Dr. CLARK, of *Finmere House, Oxfordshire*, is an accomplished amateur horologist, who exhibited an astronomical clock impelled by gravitation, the escapement to which was considered one of the most notable novelties in the exhibition of clocks. It is said never to trip with any bearable weight, and does not require oil. We should be happy to receive from the learned inventor a detailed explanation of the parts and construction.

CAPTAIN H. B. COATHUPE, of *Abington Street, Kensington*, is, we believe, the inventor of the mercurial time keepers, christened "atmospheric clocks," but which he exhibited under the alias of "everlasting clocks." This so-called clock is more like a thermometer in appearance, and appears a toy more curious than useful. It consists of an inner tube of glass, plugged near the open ends. A thread of mercury about an inch long is enclosed, and the tube is sealed up in a covering tube.

Being hung upright, the mercury by its gravity forces the air through the lower plug, its descent being regulated by the adhesion of the mercury to the upper plugged end of the tube. The lower part of the mercury is made to indicate the time, on a scale of wood and paper, iron, glass, enamel, &c., to which the instrument is attached by spring clips, through which it slides so as to admit of adjustment. When the mercury has all reached the lower extremity, the instrument must be reversed, and it then acts similarly.

J. F. COLE, *Queen Square*, exhibited chronometers, watches, tempered springs of really marvelous fineness, tenacity and elasticity; also models of his numerous inventions, most of which the accomplished artist has himself described already in the Horological Journal. Amongst these were his new suspensions for pendulums, which although yet untested deserve notice.

We have already stated that we deemed his new auxiliary compensation balance the most original of the many novel arrangements exhibited. It has a differential motion of the weights. The critique from the French, which we print in this number,

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sufficiently testifies to the merits of Mr. Cole's display, and renders it unnecessary for us to say anything further.

J. Cole, *Castle Street, Holborn*, displayed ornamental and portable clocks of original construction, and of elegant artistic designs. An original arrangement for an electric clock, table or bracket size, possessed great merit.

W. Ehrhardt, *Birmingham*, sent specimens of various watches, and a pair of gauges or pitching tools of his own invention, for planting the lever escapement. One gauge gives the angle of the pallets, and the distance the pallets and escapewheel holes must be apart, on a scale divided to the 2500th part of an inch. Another marks the distance found with the first on the watch, having a similar division of the inch. They can also be used in pitching all other escapements as well as ordinary wheel depths.

C. G. Gumpel, *Brixton*, sent electric clocks, which have several improvements. The oscillations of the pendulum are independant, and free of any influence from the moving power, whether gravity or electricity. The pendulum is composed of a wood rod having zinc compensation, and cast-iron bob. The acting weight suspended from the curved lever, for the purpose of uplifting the impulse arms, weighs $2\frac{1}{2}$ drachms, exerting a longitudinal pull of about $1\frac{1}{2}$ drachms at the point where the arms hold the curved lever, so that the actual force required to disengage the arms is a small fraction of a drachm. The hooks of the curved lever and the pin in the impulse arms are hardened and polished cast steel. The contact makers are formed of iron cups, containing mercury, into which dip pieces of copper having iron ends. One enters the mercury before the other leaves, so that no spark from the direct current can oxidize the surfaces of the contact makers as both transmit the same current alternately; the left one to the magnet of the pendulum, the right one to the clock. Hitherto in the best constructed electric clocks, the pendulum makes a contact at each oscillation by bending a spring, which in itself, as the temperature varies will alter in elasticity and influence the rate of the clock.

H. Delolme, *Oxford Street*, had marine chronometers, an astronomical regulator in plate glass and ormolu case of an entirely new design. It has an improved gravity escapement; and the pendulum is suspended by friction rollers, called Vulliamy's suspension. It was first publicly exhibited in the Exhibition of 1851, and is employed in the suspension of the pendulum in the portico clock at the General Post Office. He also displayed a collection of first class watches.

J. Russel & Son, *Liverpool*, exhibited watches having hard tempered nickel movements.

J. Walker, *Cornhill*, and *Leicester Square*, had a collection of watches and clocks, among which were specimens of his *crystal case watch*, so called from the front being protected by a perfectly flat and thick crystal.

J. Young, *Knaresborough*, exhibited his improvements in the construction of chronometers and watches. The object is to gain a more easy, ready and safe means of effecting repairs so as to save time, trouble and expense. The top plates, bars, and cocks may be taken off, and any one or the whole of the smaller wheels, escapement &c., may be taken out, repaired and replaced, without letting the spring down, or removing the chain from the fuzee, or running the wheel work down.

J. Mc Lennan, *Park Place*, exhibited pocket chronometers, remarkable for their superior finish, more especially one, which was the smallest exhibited.

Dent & Co., *Strand;* this firm manufactured the clock which worked the hands to the great dial in the stained glass window at the eastern end of the nave, measuring nearly forty feet in diameter. In the eastern transept they had a turret clock, striking the hours on a bell weighing nearly four tons, and the quarters on smaller bells. Near this clock they had a smaller one, shewing the time only having a weight remontoire. The distinctive feature of their turret clocks is the employment of cast iron for the wheels.

They had besides an excellent display of chronometers, regulators, watches, and various other descriptions of timekeepers.

Cook & Sons, *York*, exhibited three turret clocks in the gallery, and one large one in the nave; also a capital lathe and wheel cutting engine.

The clocks were excellent, both in arrangement and workmanship, especially in the lantern pinions, which for large work have every good quality to recommend them.

Mr. Dennison's gravity escapement is adopted in these clocks, and in some of them is combined with a remontoire of the loose wheel and frame form—than which we do not know a better, despite the variety of forms in which this mechanism now presents itself.

But the greatest peculiarity in these clocks is the revival (if we may use that term) of a much neglected form of maintaining power, combining in the most complete manner the jack or auxiliary pinion for winding up great weights, and the means of keeping

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the piece going whilst winding. It has somewhere been stated that this was "said to be new," but we doubt if any expression of these clock makers would have borne such interpretation; at any rate we know it is not novel, and we have even seen it in a pocket watch. As but few are well acquainted with this contrivance, we may briefly say that it is arranged as follows:—

The barrel arbor is loose in both barrel and great wheel, but is pivoted as usual in the clock frame, and is squared to receive the winder. This arbor carries a small wheel working in another small wheel attached to the barrel by a stud; this second small wheel takes into a circle of pins, representing a wheel raised on the inner surface of the main wheel. It will readily be understood that on moving round the arbor, the intermediate wheel can only move round by shifting the position of the stud on which it turns. If the wheel into which it takes on the other side be fixed, it therefore winds the barrel, which latter is retained in the position to which it is so wound by the ratchet wheel on its end engaged by a click on the main wheel. Thus, as the numbers of the teeth in these wheels and pinions are arranged, the handle or winder will require moving three, four, or more turns to one turn of the barrel, and the forces will be in like proportion.

The piece is kept going while winding up by the very act of winding, for the pressure of the intermediate wheel against the circle of the teeth of pins is in the proper direction of that wheel, and thus there is rather greater force on the clock during the act of winding than is exerted by the driving weight.

G. Blackie, *Amwell Street, Clerkenwell*, sends us the following account of the chronometers shown by him.

"One had a balance of a new and simple construction, forming different *curves* on the same *lamina*, so that the amount of compensation can easily be increased if required. It is very sensitive and certain in its action in change of temperature. The principle of this balance can be applied to chronometers of the ordinary kind, making them more valuable instruments at a small cost. There was one exhibited for the purpose of showing how easily it could be applied as a supplementary auxiliary. It could not be deranged with the proper care that is required in any chronometer while under repair &c.

A third chronometer had a balance with a new auxiliary, acting direct to the centre at high temperatures, with platinum weights &c.

A fourth chronometer had a balance with a new auxiliary, acting at low and high temperatures." These balances are said to be very senitive, simple in construction, not *easily* deranged, and can be applied to almost any chronometer.

This exhibitor of inventions had likewise a very fine regulator, with a new suspension for the pendulum, which is said to prevent any reverse action. It had mercurial pendulum, pallets jewelled in sapphires &c.

W. G. Schoof, *Ashby Street, Clerkenwell*, exhibited lever watches, compensated, and sprung with improved Breguet springs; also a regulator possessing several improvements. The mercurial pendulum becomes detached from the escapement by the application of impulse to a cylindrical pallet, tapped on to the *bottom part of the pendulum rod*, so as to be easily adjusted to the fork or lever which gives the impulse, in the same manner as the balance receives it in the ordinary lever watch. The jewelled pallets, to the arbor of which the lever is fastened, embrace three teeth of the escapewheel only, as in a watch, but differ from the watch pallets in this way,—that the dead faces form part of a circle so as to cause no recoil of the escapewheel in unlocking, the lever being heavy enough to keep itself steady while the pendulum completes its vibration.

The movement and dial being under the pendulum makes this regulator very convenient for shop-windows and offices, where it is desireable that time should be shown in two different rooms by the same clock.

(*To be concluded in our next.*)

ELECTRICITY OF THE ATMOSPHERE,

(*Continued from page* 60.)

The researches of Saussure, Beccaria, Crosse, Quételet, and very recently of Thomson, have tended to shew that during the prevalence of polar currents of air, positive electricity is developed, and becomes more or less active, according to the greater or less coldness and strength of wind; but with winds from the equatorial direction there is little evidence of sensitive electricity, and, when observable, it is of the negative kind.

Of all the sources whence the atmosphere obtains its electricity, evaporation would seem to be the most abundant. This was

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first surmised by Volta, and subsequent research has confirmed his view. Whenever impure water is evaporated, the natural state of electric equilibrium is disturbed. If distilled water be vaporized, no apparent electric disturbance occurs. Place a little distilled water in a metallic dish, on the table of a gold-leaf electroscope, then drop a red-hot cinder into the dish, taking care not to touch the dish with the tongs. Evaporation immediately ensues, but there is no sign of any electric action. Now dissolve a little chalk, lime, soda, or salt in the water, and repeat the experiment. The gold leaves diverge with negative electricity. Hence the rising vapour is positively electrified, and the vessel containing the water is rendered negatively electrified. The waters on the surface of the earth are seldom quite pure, consequently we may regard the vapour which arises from them to be more or less charged with positive electricity, while the fluid from which the vapour has arisen, is deficient of electricity, and is said to be negatively charged. The natural process of evaporation proceeds invisibly and silently, hence we may be led to undervalue its agency in accumulating those vast stores of electricity which arm the storm with such terrific powers. We may, however, form some idea of the extent of evaporation over all the rivers, lakes, and seas, and the boundless ocean, when we reflect that it has been computed that between two and three hundred millions of hogsheads of water are evaporated daily from the Mediterranean Sea alone.

Condensation, the reverse process to evaporation, inasmuch as it is the reconvertion of vapour into the fluid state, may readily be supposed another cause of electric disturbance. This seems to be proved by the hydro-electric machine, invented by Sir W. Armstrong, which developes electricity by the condensation of steam.

During *combustion*, the electrical equilibrium is destroyed. It has been found that while a substance is burning, positive electricity escapes from it, and it becomes itself negative. Hence the atmosphere is the receptacle for a vast amount of positive electricity, originating from the process of combustion.

The phenomena attending vegetation are considered to cause electric disturbance. Friction also must not be omitted. By friction we produce electricity artificially, If a piece of silk be well shaken in the air, it becomes electrified; and it is highly probable that when currents of air encounter each other, as opposite winds meeting, or upper and under currents flowing in different directions, the friction of their surfaces generates electricity; and the colder becoming positive with respect to the warmer, the process of interchange may indicate upon the instruments great inequalities of electrical tension. The friction of winds in passing over mountains, hills, buildings, trees, and elevated objects generally, may possibly set free electricity, so that we can understand why thunder storms are almost always accompanied with strong winds, and rarely occur in calm weather.

The shell of air and vapour which envelopes the world, and which we call the atmosphere, must, therefore, be regarded as the grand theatre for the displays of free electricity. In it accumulates, it would seem, all the electricity liberated by the various operations of nature, in the unceasing interchange which pervades the various elements of the material world. The solid earth, and its fluid mantle, form the arena in which this mighty agency is laid to rest, or neutralized. There is at all times perceptible electricity in the atmosphere; but it is not constant in kind, and varies greatly in intensity. By the inductive law of free electricity the surface of the earth has invariably an opposite electric state to that of clouds, or vapour, in the air immediately over it.

It is important to bear in mind that dry air being a non-conductor of electricity, the presence and retention of free electricity in the atmosphere is owing entirely to the vapour diffused. The vast quantity of vapour unceasingly formed from some portion or other of the large inland waters and the oceans, ascends imperceptibly into the air, until it is partially condensed by the cold of the upper regions, when it becomes visible from its imperviousness to the sun's rays; and, broken into parts by the varying currents of air or other causes, possesses however sufficient cohesion among the particles to maintain them in masses more or less large and compact, which we denominate *clouds*.

Since the generation of vapour produces electrical disturbance, clouds, besides being vast stores of gaseous water, are magazines of free electricity. As the vapour condenses from loss of heat, and the clouds become more compact, the area over which the electricity is distributed is diminished, and the electric tension is proportionally increased. Clouds also may lose their electricity by conduction through invisible vapour present in the air. Hence it appears perfectly possible for different clouds to have different electric conditions. Clouds similarly electrified meet and coalesce without any visible display of electricity; but

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when clouds differently electrified come together, a thunder storm results.

The first indications of an approaching thunder storm are a heated, sultry, very oppressive atmosphere, bearing light fibrous curl-like clouds, which stretch in long lines over the sky, and are called *cirrus* clouds. These small fleecy clouds rapidly increase, by accumulating the surrounding vapour, and by extending and uniting, into clouds termed *cirro-cumulus*, little round masses which lie near together. These become larger, heaped-up masses, called *cumulus*, dazzling white clouds with intervening deep blue sky. Subsequently the sky becomes scattered over with clouds, which sometimes seem to ascend from all parts of the horizon. The storm clouds are dark, rugged masses, with sharp and jagged edges, having a more threatening appearance than the *nimbus* or rain cloud proper. The breaking forth of the storm is generally preceded by a fall in the barometer, and a partial darkness.

Thunder storms are always preceded by the formation of clouds; and it is well known that they generally occur in the warmer part of the year, and are most frequent in the torrid zone. At that time and in this region, the heated state of the air renders it capable of taking up the greatest quantity of vapour. If the vapour is generated quickly, and the superincumbent air is dry and hot, it escapes to the cloud region charged with positive electricity. If there be in the air a tendency to cool down, it will be soon rendered palpably moist, become a conducting medium, and carry off the electricity of the aqueous vapour invisibly to the earth, while at the same time the process of evaporation would almost cease.

Thunder clouds of large dimensions sometimes appear much agitated. This is thought to be occasioned by the centre of the cloud being more highly electrified than the surface. Mr. Crosse found this to be so, almost without exception. Most likely this is the result of the slow conduction of the surrounding air. A continual tendency to equalize itself, and a constant loss of electricity may be the causes of this agitation. Probably the loss of heat, beyond a certain stage, produces agitation as well as sudden condensation, and causes the particles of vapour to form into drops of water, which being too dense to remain suspended in the air, fall to the earth in the form of rain. By this process the electricity of the vapour will be so accumulated on the surface of the drops, that its tension will be sufficient for discharge into a proximate mass of cloud, or the earth:—when a flash of lightning occurs. The formation of rain then, on this view, is the cause of the lightning. The latter may be first apparent, owing to the swift velocity of light; but the former generally occurs after an interval such as it may reasonably be supposed to occupy in its descent. Hail, or rain in a frozen state, may perhaps be produced by a sudden subtraction of heat by a stratum of very cold air, through which the shower passes from a cloud at great elevation.

By the law of induction, a body electrified positively will induce a negative electric state in an opposed body, provided a non-conductor lies between them. Now these are the circumstances of the existence of thunder clouds. The clouds are electrified positively:—the imperfect conductor, air, separates them from each other and the earth; and thus they act inductively upon each other, as the electricity of one may be negative with respect to that of another; or the earth, or sea, immediately under them becomes negatively electrified. In this manner then, clouds undoubtedly act upon each other, or upon the surface of the earth, precisely as positive electricity on the inside of a Leyden jar acts upon the outside coating; in the one case the intervening insulator is air, in the other glass. Like all other electrified bodies, clouds charged with electricity exert a tendency to neutralise themselves, or attain a state of equilibrium, by parting with electricity, if positive—or by receiving more, if negative—with respect to other bodies in the vicinity. Wherever the law of induction is operating, the law of attraction of dissimilar electrified bodies is likewise in force. Hence, if the inductive action exists between two clouds, or between clouds and the earth, the clouds will move towards each other, or they will assume a lower position in the atmosphere, until the force of attraction, which is found to increase in proportion as the square of the distance apart decreases, is sufficient to overcome the resistance of the interposed air to the passage of the electricity, when the excess of electricity of the one passes over or unites with that of the other, and electric equilibrium is the result. The transfer of electricity is accompanied with the flash of lightning, which is analogous to the spark attending the discharge of a Leyden jar. The length and strength of the flash will depend uppn the dimensions of the clouds, and their difference of electric tension. It may be so feeble as hardly to be visible, or it may have a blinding brilliancy.

(*To be Continued.*)

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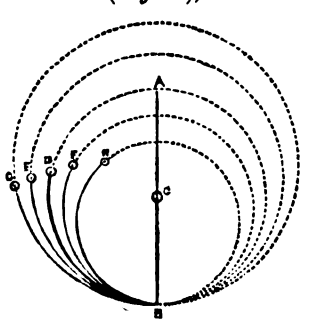
DENT'S AUXILIARY BALANCE.

The following is a description of a new auxiliary balance invented by M. F. Dent, 33, Cockspur street, London, and exhibited at the International Exhibition, 1862:—

By comparing a well made metallic thermometer with a mercurial one, we find that laminæ, composed of brass and steel, when properly made, bend regularly by regular changes in temperature, and that the rims of a balance, therefore, bend with regularity. As this is the case, an ordinary compensation balance possesses more compensative power in high than in low temperature; which can be proved in the following manner:—

In Fig. 1,* *a b* represents the arm of a balance; *c* the centre; and *b d* one of the compensation rims, standing circular with the centre in a middle temperature of 66 deg. If the end of that rim *b d*, by a change of temperature of a certain number of degrees above middle temperature, moved into *f*, it would, in the same number of degrees below middle temperature, move out to E; for F B and E B are of the same length as D B, when measured along the lines, and are parts of circles, of which one is as much larger as the other is smaller than the circumference of the balance in middle temperature. When the distance from the centre to F, D, and E is measured, it is found that a compensation weight placed on the rim, in moving from D to F, passes through a greater space, and approaches the centre of motion in

(*Fig.* 1),



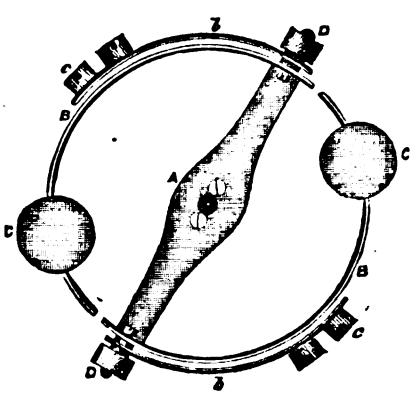
a greater ratio than in moving from E to D, and, therefore, as the velocity with which a balance vibrates is in direct proportion to the distance of the weights from the centre, ordinary compensation balances must possess more compensative power in high than in low temperatures. It therefore appears, that the cause of chronometers going slower in extreme than in middle temperature is that pendulum springs, by regular increase in heat, lose strength in an increasing ratio, and in a greater proportion than the compensative power of the balance increases in the same temperature.

But, by again referring to the diagram, it will be seen that if the compensation rims, by the same changes of temperature, moved through a greater space—as, for example, from G to H—that that addition in the action from F to H would become larger than the addition from G to F; and consequently, by causing the compensation weights to pass through a greater space, the compensative power of the balance is increased in high temperature.

This increase in the action of a new balance, invented by M. F. Dent, is obtained by making the compensation rims thinner. But, in addition to this alteration, are fixed two other rims on the timing screw studs (see *Fig.* 2, D D). These rims have the brass inside and the steel outside, and are provided with a series of screw holes and heavy platina screws. As these rims expand in heat, and contract in cold, they not only counteract the too great effect on the compensation produced by the increased action of the primary rims, but, as they, like the primary rims, act more when they are moving in, than when they are moving out, from their position in middle temperature, they likewise assist in making the chronometer go faster in cold.

In Fig. 2, A is the arm of the balance; B B, the compensation rims; C C, the com-

(*Fig.* 2.



pensation weights; D D, the timing screws; B B, the auxiliary rims; and C C, the platina screws. These platina screws are placed nearer to the arm A, if the chronometer goes too fast in extreme temperature, and *vice versa*.

* Fig 1 is inaccurately carried out by a mistake of the engraver. The distances between the circles, of course, ought to be the same.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., December, 1862.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	29·702	42	41	42	35	SE	2	m	omr
2	29·595	40	39	44	37	E	2	m	cm, b
3	29·738	43	42·5	45	38	E	4	om	o, mr
4	29 813	45	44	46	43	E	2	mr	om
5	30·050	51	50	51	44	S	2	om	or, b
6	30 050	54	52 5	54	50	SW	6	o	o,r,bm
7	30·066	52	50	56	50	SW	3	o	om,b,r
8	30·012	43	40·5	55	42	NW	7	b	o, bm
9	30·145	43	40	44	40 5	WSW	2	o	o, rr
10	29·696	52·5	51	52·5	42	W	6	c	c, bm
11	29·994	42·5	39 2	53	38	WSW	3	cm	o, r, m
12	30·231	37·5	35 5	50	36	NNW	4	m	c, b
13	30·048	45	42 5	45	36·5	SW	7	r	r, bm
14	30·390	38·3	37	47·5	35 5	W	2	cm	cm, bm
15	30·432	40 5	39	44	35	S	1	m	mc, bm
16	30·343	41·5	40	43	38	SW	1	cm	mo,m,r
17	30 311	51	49	51	41	SW	6	m	m,r,bm
18	30·344	41·5	40	52	37	W	3	m	r, bcq
19	29·758	48·5	43·5	52·5	41	WNW	8	bc	cb, bq
20	29·560	39·5	35 5	49	38	NW	8	b	b, or, b
21	29·866	39·3	35 3	44	36	N	9	cb	bcpq
22	30·172	37	36	42	35	NNW	4	mc	om, r
23	30·060	41 3	40·6	41·5	35	W	1	ff	m
24	30·275	44	43	46	40	W	1	f	mo
25	30·340	46·5	45	46 5	43	N	1	cm	bcm
26	30·310	46·5	43	49	38	W	6	bm	q, c
27	30·448	44·5	43	49	41	SW	2	m	r, m
28	30 143	49	46	50	43	NW	4	c	cb, m
29	29·592	48	46	51	46·5	SW	6	o	rr, bm
30	29·485	42	41	50	41	N	1	cm	cb,r,cb
31	30·132	38·5	36.5	45	37	WSW	2	m	cbm
	30·036	44·1	42·2	48·1	39·8		3·8		Mean.

Remarks.

At 10½ p.m. 14th, and at 9 a.m. 27th, the atmospheric pressure was 30·448 inches; and this was the highest observed. The table shows low pressure on the 2nd, 20th, and 29th, at 9 a.m., but the lowest was 29·47 at 8 a.m. 30th. The extreme range therefore, was about 0·987 inch.

Tempestuous weather prevailed on the 19th, 20th, 21st, and moderated on the 22nd, begining with the wind at the sw and ending with it at NNE.

Rain fell on 17 days, during about 66 hours, to the amount of 1·44 inches.

According to the table, the wind blew from N on 6 days; E, 4; S, 6; and from W on 15 days.

During the year 1862, the rainfall amounted to 25·67 inches. Rain fell on 179 days, that is on nearly every other day. The hours of rain were estimated at 904; therefore, if the rain had fallen continuously it would have lasted nearly 38 days and nights.

According to the 9 a.m. observations, during the year 1862, for every day that there was a calm, the wind blew from the E, 5·5 days; S, 7; N, 8; and from the W 12 days. The north and south winds therefore prevailed about equally while the west winds were predominant, and were more than twice as frequent as the east winds. The average force of all the winds was 3, (on the sea scale of estimation), equivalent to an hourly velocity of about 15 miles, and a pressure of about 1 lb. on the square foot.

List of New Members.

Mr. G. Muncaster, Ashton under Lyne.
" F. Browning, 41, Hall-street, City Road.
" John Heward, 13, Myddelton-street.
" Butler, St. Helen's, Lancashire.
" Robert Young, Optician, Greenock.
" Maclennan, 6, Park place, Highbury Vale.
" Sylvain Mairet, Locle, Switzerland.
" J B. Gibbons, 45, Hatton Garden.
" O. Vivier, 21, Seckforde-street.
" Edmund G. Lawrence, 27, Northampton-sq.
" Mark Stevens, 31, Myddleton-street.
" White, 9, Green Terrace, Clerkenwell.
" March, 32. Alfred-street, City Road.
" R. Ball, 31, Sudeley-street, City Road.
" David Gill, Jun., 152, St. John-street Road.

Obituary.

We regret to have to announce the death, from pleurisy, of Mr. P. Macdonald, at his residence, 61, St. John's Square, on the 22nd December last, at the early age of 44.

He had not been many months in his new place of business, and had every prospect of increased prosperity. As printer of this Journal, from its commencement, he was ever desirous of aiding and meeting the necessities of the Institute.

All Communications for this Journal should be addressed to the Editor, *at the Office*, 35, Northampton Square, Clerkenwell.

London: Printed for The British Horological Institute, by Macdonald & Co., Steam Printing Works, 61, St. John's-Square, E C.; and Published by Kent & Co., 51, Paternoster Row.

The Journal may also be had at the following Watch Tool Warehouses:- Delolme's, Rathbone-place; Ehnhuus 53, Frith-street, Soho-square; Grimshaw, 159, Goswell-street; E. Hunt, Ironmonger-street; Lowther, Red Lion-street; Muller, King-street, Soho; E. J. Thompson, 5 & 6, Percival-street; Williamson, Frederick-place; Greenhill, Sutton-street; Haswell, Spencer-street; C. B. Johnson, Market-place, Prescot, Lancashire; Margetts, "P.O." Goswell-street; and of all Booksellers in Town and Country.

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SYSTEM OF MEASUREMENT AND CALCULATION,

PROPOSED BY

MORITZ GROSSMANN, WATCH MANUFACTURER, GLASHUTTE, IN SAXONY.

Having perused No. 32 of your journal, and the special invitation you were kind enough to forward with it, I felt very much pleasure in experiencing the great value you attach to a uniform system of measurement for watch making and engineering purposes, and I think it highly creditable to the Institute to have taken the initiative in this cause.

I have no doubt that many systems of measurement will be offered to your examination, and especially many systems based upon the French and English line, and such like measures. Nevertheless, I beg to solicit your attention for another proposal, bearing in quite a different direction, which in my humble conviction has a great superiority over any other system known to me, and would, if generally adopted, not only offer the great advantage of uniform measurement in the trade, but, more than that, afford a great facility in finding the correct proportions for every part of the mechanism, by the means of easy and simple calculations.

Before I enter into this matter, I feel it my duty to declare, that the honour of the first adaptation of this system, as well as of the construction of the instruments required for this purpose, is due to the founder of the watch manufacturing in this place, Mr. A. Lange.

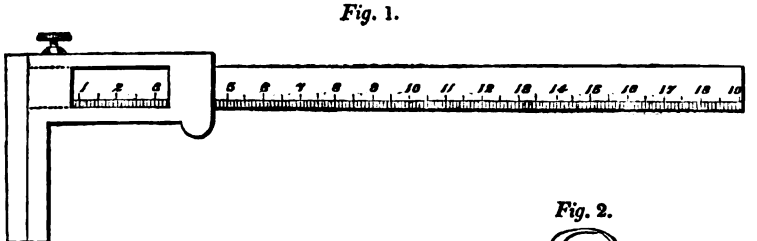
The system mentioned is the French mètre, and if we plead its cause, it may at least not be said that we are partial for something of German origin; besides, we consider it as beyond any doubt that the superiority of the French system will soon be acknowledged all over the civilized world.

The metre has been adopted here as it is, with the only difference that we use not the metre, but the millimetre as the unity of our sizes. The millimetre is a very convenient quantity for watchwork, because being much smaller than the French and English lines, it gives best fractions in the sizes. (1 French line = 2·26 m.; $\frac{1}{10}$ English inch = 2·54 m.)

The millimetre is subdivided into tenths and hundredths; these latter are commonly called degrees, because they are measured on an instrument with a dial.

I shall now shortly describe the instruments for measuring as we use them here; there are three of them. 1st—The metre measure is a kind of sliding gauge with

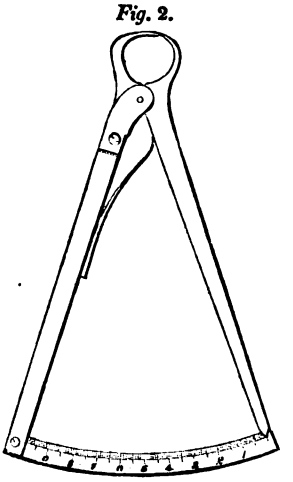
Fig. 1.



angular arms, between which to put the object to be measured. The rule is divided in millimetres, and by means of a nonius the tenths can be read. This tool is at the same time a very handy rule and angle for filing, &c., and very convenient for measuring the diameters of wheels, plates, glasses, &c. with great accuracy. It proves very useful also for clock making, as even depths may be pitched with it, with all correctness required, if the primitive radii of the wheel and pinion are known. The division usually extends to 200 millimetres.

2nd—The tenth measure is a very simple instrument, the form of which is shown by the drawing, and does very good service

Fig. 2.



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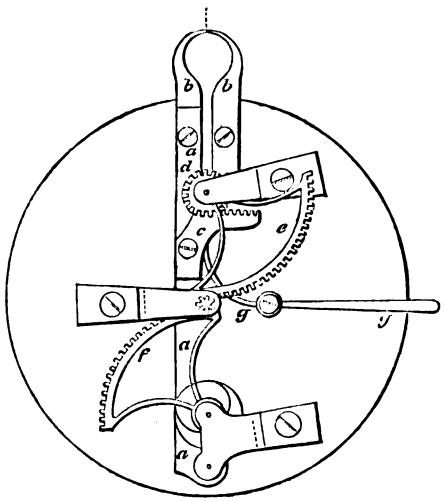
for all kinds of lathe work, for measuring the bottom of a sinking or barrel, the height of a spring, the thickness of plate and wire, &c. It may be said not to be altogether correct, as it measures the arc instead of the chord; but this error is compensated as much as possible, by transferring the division on the arc from a straight line divided into 100 equal parts.

This measure admits an opening of 10 mill. (one tenth of the mill. is = ·044 of the French line.)

3rd—The micrometer is an instrument for

Fig. 3.



measuring the smallest objects, and one degree on it is ·01 mill. (= ·0044 of the French line.) This division is fully small enough for any purpose, for there is no object I know of thinner than one degree, and even the human hair shows a thickness of 4·6 degrees. The drawing shows the form and inner disposition of the micrometer. It consists of a large lever *a*, carrying on its outer end one half of the tongs *b b*, the other half of which is screwed upon the plate. Upon about ⅔ of its length the lever carries a rack *c*, pitched into a pinion *d*, fixed on the arbor of the small rack *e*. This latter leads the centre pinion, which is constantly moved backward by the force of a pendulum spring, transmitted by the rack *f*, so that the centre pinion takes between the teeth of the two racks freely, but without any shake. A small angular lever *g*, projecting from the case, opens the tongs by being pushed by the finger in the direction towards the tongs. The object to be measured is inserted between the tongs, and keeps them from being shut by the action of the pendulum spring.

The hand on the centre pinion shows on the dial the distance at which the two parts of the tongs are kept, or, which is the same, the thickness of the object between them. The tongs can be opened wide enough to measure objects of 6 m. (¼ inch) in thickness. The micrometer it is true has the same error of measuring the arc instead of the chord, and in this instance the error could not be counteracted, but it is reduced to the smallest extent possible, by taking the length of the lever from its moving centre to the acting part of the tongs, as large as could be done; so that the widest opening of the tongs for an object of 6 m. requires only an angle of movement = 5°. The error arising by the difference between arc and chord of so small an angle will be so very trifling, that it may be neglected altogether, even where the greatest accuracy is required.

As may be seen by the above explanations, it is not a mere scheme or idea I submit to your examination—it is a system which has already gone through a proof of more than 20 years daily use; it is indispensable to any manufacturer or workman here, and answers perfectly, and better than anything else for all our purposes. But more than that, you may also have the measuring instruments well executed at the shortest notice; as I saw myself, occasioned by the increasing demand of this and other places to get them up in a manufacturing way, and thus am enabled to furnish them at moderate prices, allowing a handsome discount to wholesale buyers.

Having now explained the system and instruments of measurement as we use them here, it remains but to illustrate by some examples the ways, in which the real proportions of the work, can be calculated or reduced from models or drawings on a larger scale; which is I feel pretty sure not the least advantage of this system; the manufacturer being enabled by it to carry on his business in a more positive and scientific way. We have drawings and models as correct as we can wish for, but what is the use of having them if we have not at the same time the means of transfering their proportions with the same correctness to the small dimensions of our work?

There are different ways of using our measuring system for giving the right sizes and proportions to our work. The easier and simpler way is the graphic method, by merely drawing on a large scale and then to reduce all the sizes of the drawing to the real size of the work.

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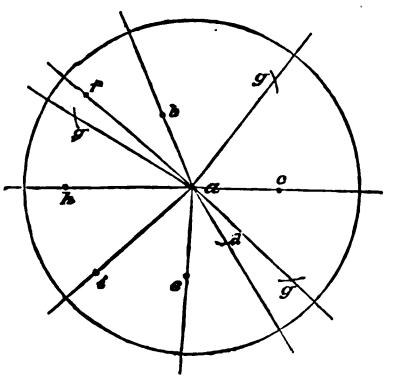
The most convenient scale for drawing movements &c. will be as 10 to 1; then of course 1 m. in the drawing will correspond to one degree of the tenth measure or 10 degrees of the micrometer for the real size of the work. For escapements &c. a more magnifying ratio will be required, for instance, 20 to 1 or 50 to 1. Suppose it is required to execute a movement or any thing else in a smaller or larger scale, but exactly similar to the other; you need only take the drawing and draw straight lines from the centre to every point of it. As the angles must remain the same, the only thing to do is, to alter the centre distances of the points as much as required.

Example.—The diagram represents an

Fig. 4.



English three-quarter plate movement, the diameter is 44 m. This movement is to be executed with a diameter of 37 m., but exactly proportionate to the first one in disposition and sizes.

The proportionate number is 37: 44 = 0.84. If we multiply the centre distances of the movement of 44 m. with this number, we have the exact centre distances of the new measurement 37 m., and if we remain on the same lines we keep also, exactly the same respective dispositions of the parts to each other.

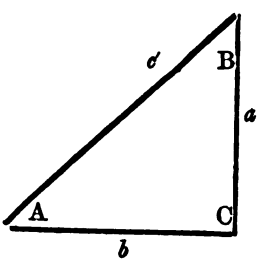
	In the Movement 44.	In the Movement 37.
Centre distance of fusee	a. b —9, 9m — 9,9.0,84 = —8·32 m	
" " barrel	a. c —11,8 " —11,8.084 = — 9,91 "	
" " third wheel	a. d—9,0 " — 9,0.0,84 = — 7,56 "	
" " fourth	a. e—11,6 " —11,6.0,84 = — 9·74 "	
" " click	a. f—18,7 " —18,7.0,84 = —15·71 "	
" " pillars	a. g—18,0 " —18,0.0,84 = 15,12 "	
" " cock-screw	a. h—16,4 " —16,4.0,84 = 13,78 "	
" " "	a. i—17,0 " —17,0.0,84 = 14,28 "	

If there is any other way of attaining the same results, I am quite sure that the one just mentioned is the easiest and simplest, the calculations being mere multiplications. In the same way the exactly corresponding diameters, thickness &c. may be found.

The other method which I formed for my own use and find in many points superior to the first mentioned (which nevertheless, is certainly sufficient in all cases) is, as I am fully aware of, not very likely to be more generally employed by practical workmen, still I think that some of those, who may read these lines, may perhaps take an interest in it.

It is based upon the Trigonometrical calculations of the angles and lines of triangles, out of the parts which are known. I generally make use myself of the formula for the rectangular triangle, as follows

In this rectangular triangle C is the right angle and c the hypothenuse, A & B are the two acute angles and a and b the cathetes opposite to them.



The following little table shows the formulæ for the unknown parts out of those which are known.

KNOWN.	TO BE FOUND	FORMULÆ.
I. a, b,	$\angle A$	$\text{tang. } A = \frac{a}{b}$
	$\angle B$	$\text{tang. } B. = \frac{b}{a}$
	c	$c = \sqrt{a_2 + b^2} = \frac{a}{\sin A} = \frac{b}{\cos A}$
II. a, c,	$\angle A$	$\sin A = \frac{a}{c}$
	$\angle B$	$\cos B = \frac{a}{c}$
	b	$b = \sqrt{c_2 - a^2} = \sqrt{(c+a)(c-a)}$
III. a, $\angle A$	$\angle B$	$\angle B = 90° - A$
	b	$b = a \text{ cotang } A$
	c	$c = \frac{a}{\sin A}$
IV. b, $\angle A$	a	$a = b. \text{ tang } A$
	c	$c = \frac{b}{\cos} A$
V. c, $\angle A$	a	$a = c \sin A$
	b	$b = c \cos A$

At first sight this looks very complicated and difficult, but the calculation is very simple, as the example will sufficiently prove, besides it is by no means required, to go

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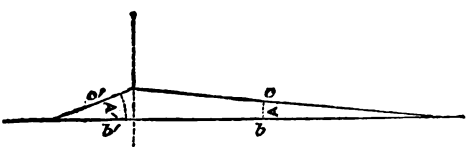
through a course of trigonometry for calculating in this manner. The only thing required is to employ the formula answering to the given case, to substitute the given numbers into the formulæ and to acquire a little practice in the use of the tables of trigonometric lines which are to be fouud in many mathematical or nautical hand-books. All the rest is mere multiplying and dividing.

Example. It is required to find the disance of centres between balance and pallet of a detached lever escapement and the acting length of the lever; the acting radius of the roller, as well as the two angles of lifting being given

Fig. 5.



Given—The acting radius of the roller $C' = 1{\cdot}18$
The lifting angle $A' = 19°$
" " $A = 5°$

By drawing a rectangular line from the top of the triangle to the line of centres, the triangle is divided into two rectangular ones and the line of centres into the two parts b & b. For the smaller of the two triangles, the known parts are $C' = 1{,}18$ and $\measuredangle A' = 19°$ this constitutes the case for employing the formula V for finding the length of a

$a = c' \sin A' = 1{,}18.0{,}326 = 0{,}384$ m.

For the larger triangle we have now the side a and the opposite angle A. This is sufficient to find the length of lever c, according to formula III.

$$c = \frac{a}{\sin A} = \frac{0{\cdot}386}{0{\cdot}096} = 4{,}00 \text{ m}$$

The distance of centres $b + b'$ is now very easily found by formula *V*.

$b = c.\cos A = 4{,}0{,}995 = 3{,}98$ m.
$b' = c'.\cos A' = 1{,}18.0{,}9455 = 1{,}12$ m.

$b + b' = 5{,}10$ m.

Having found the correct respective proportions between the acting length of the lever, the acting radius of the roller, and the centre distance, it is very easy to form a general table for finding the two other of these lines, if one of these is given.

The lifting angles being supposed 5,5° and 19°	Proportional Numbers for Centre Distance	Length of Lever	Radius of Roller
I. Centre distance = 1	1,000	0,786	0,232
II. Length of Lever = 1	1,240	1,000	0,295
III. Radius of Roller = 1	4,314	3,390	1,000

Example.—The centre distance is to be = 6,1 m. For finding the other two lengths corresponding to it, we need only take the proportional numbers of the line I, and multiply them by 6,1 m.

Length of Lever = 0,786.6,1 = 4,79 m.
Radius of Roller = 0,232.6,1 = 1,42 m.

It must be understood that these proportions correspond merely to the lifting angles 5,5° and 19°; in all cases where other angles are wished for, the proportionate numbers must be found in a similar way.

This method of calculating, which I hope has been satisfactorily explained, has the undeniable advantage of making me entirely independent of a drawing. I only need a rough sketch, which may be made without rule and compasses, merely to show the letters the sides and angles are marked with. The graphic method is liable not only to the errors of drawing, but also those that may occur in taking the lengths off from it, and besides, I want more time to make a correct drawing than for the very simple calculations of the other method. In matters of doubt, the results of both may control and confirm each other.

The above examples, I think, will show sufficiently the applicability of our system of measurement and calculation to all engineering and watchmaking purposes, and I fear I should trespass upon your patience by giving more examples. I only beg to mention, that I am ready to explain, if you wish it, the way we use here to make the teeth of our wheels of the shape prescribed by theory.*

I find in No. 26 of the journal a communication of a mode of shaping teeth epicycloidally, which will perhaps do well enough for constructing the wheels of a mill work, but is quite out of the question for watch work. Still it is a known fact to all of us, how far the teeth of wheels are generally from the form they ought to have.

If I propose this system of measurement to you, it is not only for its superiority for the mere measuring, but also for its applicability to calculations, which is certainly very valuable. I may assert, without being arrogant, that any one who exchanges his actual way of measuring against ours, will certainly not lose by the exchange. Besides it is most likely that the metric system will soon be a common good of all nations, and it is already resorted to in many scientific works.

For further illustration of the above mentioned instruments, I shall take the liberty of presenting to your museum a tenth

* We shall be most happy to print any communications on the subject.

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measure and a micrometer, and forward them with the earliest opportunity, begging that you will accept them as a slight token of the interest I feel for the Institute and its endeavours.

(Signed) M. GROSSMANN.

Glashutte, Saxony.

A large blue book has just been published bearing on the above subject, being the report of Mr. Ewart's committee of the House of Commons "On the practicability of adopting a simple and uniform system of Weights and Measures, with a view not only to the benefit of our internal trade, but to facilitate our trade and intercourse with foreign countries." This committee called before it an immense number of witnesses distinguished for eminence in science and commerce both in our own country and on the continent. The concurrence of opinion exhibited in their testimony is most remarkable and has led to perfect unanimity on the part of the committee in adopting the report which is appended to the evidence. The committee recommend "that the use of the metric system be rendered legal and that a department of weights and measures be established in connection with the Board of Trade."

For the information of the readers of the Journal and in further elucidation of the paper printed above we may briefly state the nature of the metric system. It was first adopted by the Academy of Science of Paris after an elaborate investigation of the subject, in which investigation deputies from other countries were invited to join. It was determined to take as the unit of length, a measure taken from the dimensions of our planet, amounting to the ten millionth part of the distance between the pole and the equator or the ten millionth part of a fourth of the earth's diameter. The actual measurements of this unit were undertaken during the worst part of the time of the French Revolution, and occupied ten years in its accomplishment. Having fixed on the unit, the commissioners adopted for nomenclature Latin and Greek words for ten, hundred, thousand, and ten thousand, to express respectively the gradations upward and downward. Thus for multipliers then are added to the respective units the following Greek prefixes:—Deca, viz. 10 times; hecto, 100 times; kilo, 1,000 times; myria, 10,000 times. For divisors there are added to the respective units the following Latin prefixes:—Deci, viz. 10th part; centi, 100th part; milli, 1,000th part. This will perhaps be best shown by the following table, referring only to measures of length, that part of the subject being the one with which we have more especially to do.

Names.	Value.	English Equivalents.
Millimeter	1000th part of a meter	0·03937 of an in.
Centimeter	100th part of a meter	0·39371
Decimeter	10th part of a meter	3·93708
METRE	- - -	39·37079
Decameter	10 metres	32·80916 feet
Hectometer	100 ,,	328·09167
Kilometer	1000 ,,	1093·63890 yards
Myriometer	10000 ,,	10936·38900

It may be in the recollection of our readers, that some time since the Institute took up the question of a system of measurement, and formed a committee for the purpose of gathering information on the subject. Circulars were sent to various quarters, asking for ideas and facts. All that has been gathered from English sources has gone to show that a similar state of things exist to that borne witness to before the parliamentary committee. No sort of system seems to be adopted, or even attempted by horological trades, and many make use of guages, without even understanding the origin of the scales laid down thereon. Where the English inch has been adopted as the unit, there has been no sufficient check on the accuracy of the standard to make the procedure of any value for intercomparison, and, worse than all, few have seemed disposed to take much trouble in setting matters right. From abroad we have received different accounts, and the above paper from a correspondent in Saxony will indicate a few of the immediate advantages which would result from the adoption of a simple system. We have waited for the close of the Exhibition and still more for the publication of the Parliamentary report before placing the matter before our readers. We would urge upon them the necessity of adopting a system so widely approved as the metric system, and would point out the folly of introducing any, even if it be the smallest, deviation from it. The value of such a system must consist, especially with us, in its universality and the evidence before the parliamentary committee as well as that which is afforded in the above paper, goes very far indeed to prove that measurements which have been gradually and successively adopted by France, Holland, Belgium, Italy, Spain, Portugal, Switzerland, Greece, and several countries of South America, must ere long become the system of the world.

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The course of horologists is therefore easy. *Let all our gauges be divided according to the metric system.* In the case of our movements the size can be stamped as before by the side of the new notation and very soon we shall find our advantage in the change. We shall be happy to receive any correspondence on the subject for publication or otherwise.—W. HISLOP, *Chairman of Gauge Committee, B.H.J.*

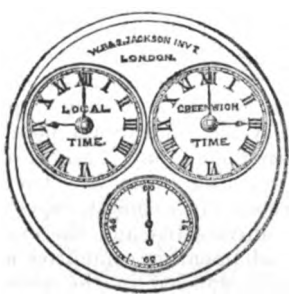
THE HOROLOGICAL SECTION OF THE INTERNATIONAL EXHIBITION.

(*Concluded from page 70.*)

In our notice of Mr. S. JACKSON's display, in our last number, we were not quite correct in our statement regarding the two watches made with Mr. Cole's escapements. The exhibitor has informed us that one has a *resilient* lever, the other the last patented escapement, the *repellent* lever, and that this watch was the first made with it.

We are now enabled to illustrate the external appearance of two watches described therein, *viz.*—the day-of-month watch, and the local and mean time watch.

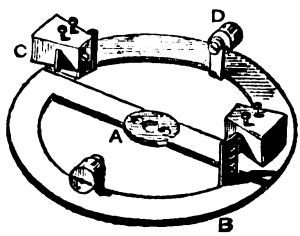
The day-of-month watch has a means of setting-on the hand from the outside, at the end of the months not having thirty-one days, which are five in the year, by simply

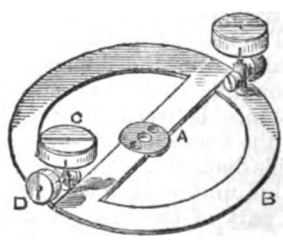


touching a button at the pendant. The local and mean time watch provides the wearer with the means of recording local time, such as that of Dublin, Paris, &c., while preserving Greenwich time independently.

GANEVAL & CALLARD, *Alfred Street, Islington*, exhibited balance springs and the wire of which they are made, for watches, chronometers, and clocks. Among the specimens were some Breguet springs, hardened and tempered; also some springs of marvellous fineness, being made of No. 75 wire, as fine as the human hair. Their improved gold pendulum springs are said to possess all the qualities of the best steel springs, besides the advantage of not getting rusty or magnetic.

V. KULLBERG, *Cloudesley Terrace, Islington*, besides being exhibitor of several ordinary two and eight-day chronometers, showed his improved eight-day chronometer on the reverse principle, noteworthy for its simpli-





city, symmetry, and finish. He also exhibited his new balance for extremes of temperature. Mr. Kullberg says, "The principle feature of this balance is, that it admits of being made in one single piece without any difficulty, thus making it solid, like the Earnshaw balance. It has horizontal flat rims, yet obtains sufficient inclination action for changing the course of the compensating weights to and from the centre, in a ratio corresponding with the loss of elasticity of the balance spring. Since the value of an invention depends on the results obtained,

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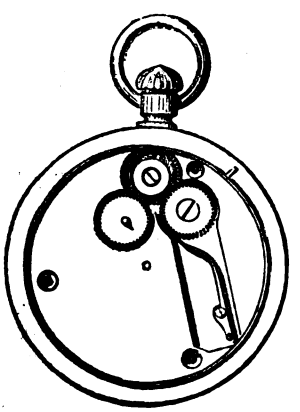
I beg to refer to the Greenwich lists lately published, and it may perhaps not be out of place to mention that the cause of failure of so many so-called auxiliary balances has been either want of *solidity*, or want of *sufficient action*, or both in *union*. The most important balance perhaps in my Exhibition case, was the hollow rimmed balance. It is simply a balance of the ordinary form in all respects, except that the laminæ, instead of being flat are made hollow, so that the sideway expansion in heat causes it to flatten and consequently diminish the resistance in heat. This arrangement reduces the error in extremes to about *one second* in 100°, 65°, and 32°, and that error, small as it is, is likely to be removed by following out the principle to a still greater extent than in the one exhibited. Should this prove the case, this balance may supersede the ordinary, as well as all others. A metal of less relative expansion than brass was used in this, as well as in the balances of the ordinary kind which I exhibited."

Mr. Kullberg likewise exhibited pocket chronometers and lever watches, with his keyless mechanism, and having a *new* index



with stationary curb pins for preserving isochronism. He says,—"It is a well-known fact that by moving the curb pin of the ordinary index to or from the stud, the isochronism is altered. In order to prevent this change, the curb pins are fixed on the spring itself, and bank upon a piece of spring fixed on the end of the index exactly above the outer coil of the spring. By this means the amount of banking is always the same, whether the index is close to or far from the stud."

In addition to the above, Mr. Kullberg's case contained a pocket chronometer, fitted with a metallic maximum or minimum thermometer at pleasure, the only one in the English section; a resilient escapement "having ordinary wheel and pallets, the resilient action being caused by an elastic banking pin in the lever, banking in a hole in the plate; and lastly "a clock escapement requiring no oil, because the escape-wheel acted on rollers, and in order to prevent excessive drop, as with 'full rollers,' the rollers were cut half away to admit the escape-wheel teeth passing near the centre of the rollers; the pallet had no pivots, being fixed on the pendulum itself, which was a thermometer tube having the bulb filled with mercury."

W. B. CRISP, *St. John's Street Road, Clerkenwell*, displayed a one-day marine chronometer with the ordinary balance; an eight-day sidereal chronometer, (the only one exhibited in the building showing sidereal time,) having Hartnup's balance; a two-day chronometer, having Molyneux's auxiliary compensation balance; and also a two-day chronometer, having an auxiliary balance claimed by several chronometer makers. Mr. Crisp writes,—"This last named compensation consists of a thin lamina of brass and steel, the steel being outside and the brass inside. This piece is fixed within the circle of the ordinary balance, and is supposed to correct the losing error of the balance in cold, it having been adjusted to heat and temperate in the first instance. I have tried several balances of this description, and cannot find any benefit from the application, as its adjustment is connected by a check screw from the rim of the balance, and consequently any alteration that is made to correct the error in cold, throws out the even adjustment for temperate and heat. I cannot consider this auxiliary any improvement, on account of its altering the rate of the chronometer so much in heat. I am speaking from my own experience; possibly some makers may have found it answer to a certain extent, by taking great pains with regard to the weight of auxiliary screw at the end of lamina, so as to have it checked as tightly as possible. This auxiliary adds a greater error to the balance, than that it is intended to compensate. Molyneux's auxiliary answers better. It may be set on to counteract the losing error of the balance in heat, supposing the chronometer to have been adjusted for cold and temperate, without altering those adjustments. These auxiliary compensation balances invented by Molyneux, have been used successfully by many chronometer makers, at the annual Greenwich trials, who have not done justice to the inventor by stating that they used his balance. I have myself used Molyneux's balance successfully

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at Greenwich trials for three years in succession; but I cannot recommend it for ordinary use, as in case of any derangement it is, like most other auxiliary compensation balances, liable to a greater error than the one which it is intended to correct. It is to the balance itself that we must look for a more accurate performance."

Mr. Crisp also exhibited a gold pocket chronometer, a gold hunting and open-faced lever watch, with the two pin escapement chronometrically adjusted, and other watches with Breguet springs, lever movements, cylindrical springs, and balances of various descriptions.

Having given this lengthened account of the principal English exhibitors in horology, we will, as a matter of justice, mention the rest. Two exhibitors of chronometers, James Brock, of *George Street, Portman Square*, and Thomas Mercer, *Spencer Street, Clerkenwell*, we regret have not sent us any particulars of their displays.

The following exhibited chronometers, watches, &c.:—

Barraud & Lund, *Cornhill.*
W. Davis & Sons, *King William Street.*
Frodsham & Baker, *Gracechurch Street.*
F. H. Holl, *City Road.*
C. J. Klaftenberger, *Regent Street.*
J. Murray, *Cornhill.*
J. Neal, *Edgeware Road.*
J. Poole, *Fenchurch Street.*
A. P. Walsh, *Wilmington Square.*
J. Hutton, *Mark Lane.*
R. Webster, *Cornhill.*

The following exhibited watches and clocks:—

Aubert & Linton, *Regent Street.*
S. A. Petit, *Leicester Square.*
C. Lange, *Strand.*
J. Sanders, *Sheffield.*
J. Fairer, *St. George's East.*

The following exhibited watches:—

F. B. Adams & Sons, *St. John's Square.*
W. Agar, *Bury.*
Guiblet & Rambal, *Wilmington Square.*
G. J. Oram, *Wilmington Square.*
A. Samuel & Son, *Charterhouse Square.*
A. Campbell, *Cheapside.*
R. Whittaker, *Great Sutton Street.*
Nicole & Capt, *Soho Square.*
O. Vivier, *Sekforde Street.*

As exhibitors of clocks:—

J. Bailey & Co., *Manchester*, showed a turret clock in tower.

Camerer, Kuss, & Co., *Bloomsbury*—1. A three part quarter skeleton on 10 bells; 2. A trumpeter clock; 3. A cuckoo clock.

J. Condliff, *Liverpool*, a skeleton clock.

C. W. Davies, *Notting Hill*, a clock shewing time and longitude of important places.

J. De Solla & Son, *Waterloo Bridge*, liliputian alarum clocks.

T. Dettman, *Minories*, an astronomical clock, constant ball escapement, compensation pendulum, &c.

J. Greenwood & Sons, *St. John's Square*, quarter and bracket clocks, regulators, dials, and cases.

Hawley's, *Holborn*, a regulator which only requires winding once a year.

Holloway & Co., *Minories*, pendulum and lever clocks of the simplest construction.

B. R. & J. Moore, *Clerkenwell Close*, turret and other clocks.

J. Muirhead & Son, *Glasgow*, house, turret, and railway clocks and "counters."

T. Quaife, *Hawkhurst*, chime clock, fifty changes, in marble and gold.

C. Shepherd, *Leadenhall Street*, galvano-magnetic clocks.

Tanner & Son, *Lewes*, clock with perpetual register of day, week, and month.

Lastly, among exhibitors of tools, &c. there were:—

B. Chevalier, *Red Lion Square*, chronometer and watch boxes.

T. Holliday, *Goswell Road*, watch cases and dials.

R. Howard, *King Square*, various styles of enamelled and sunk dials.

G. W. Leonard, *Liverpool Road*, compensation balances.

A committee of the manufacturers of Prescott, Lancashire, exhibited conjointly a collection of movements (both watch and chronometer), tools, and materials.

It is hoped that in this summary justice has been impartially done to all, and that no object of special interest has been overlooked or designedly not mentioned; and, in conclusion, in preference to any comments of our own, we commend to our readers the following extract from *Cassell's Illustrated Exhibitor*:—

"When it is remembered that in addition to the whole of the watches and clocks annually produced in England, we are under the necessity of importing, for home consumption, watches from Switzerland, and clocks from France and America, of more than £1,000,000 worth per annum, the importance of the horological department of the great Exhibition will be manifest.

"For this reason, and from the fact that, as the foreign manufacturers increased in amount of late years, the quantity manufactured at home has fallen off more than one-third since the year 1855, this year's display of the respective rivals was regarded with much interest on all sides; it is, therefore, satisfactory to know that, both in quantity and

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quality, the English manufacturer maintained a most creditable position. Indeed, several of the most eminent houses have produced chronometers, duplex, and lever watches, of the highest quality for scientific construction and for precision of performance, while, as to the external form and decoration, it was clear that the application of art to this branch of manufacture has made considerable advance in the last ten years. * * * The Frenchman is known to excel, wherever the mind and delicate touch of the artist is required to produce a thing of delicacy and elegance, and there France fairly merited the place of honour.

The lesson taught by this international display proved to the English workman that his best energies must be steadily directed to external elegance, to the higher cultivation of the fine arts as applicable to his mechanical production, and, above all, by a better system, and perhaps by enlisting the valuable assistance of the female hand, to insure a mode of manufacture which shall cheapen the cost of production. The English must produce a watch good enough and cheap enough for the million; they must give the maximum of quality at the minimum of cost; and then it will be admitted that this great concourse of manufacturing ingenuity has not been organized in vain, and that the beneficial effect in this, as well as in many other departments, will have tended alike to the advantage of the consumer and the producer. The manufacturer will flourish, the workman will enjoy the remuneration he so richly deserves, and will find the means of attaining a higher and more honourable social position; while among the whole world of watch-buyers, the next generation may hope to see, in days of more strict punctuality and more swift locomotion, that it will become for every man and every woman as much the custom to wear an elegant watch as to possess an enlightened head."

ELECTRICITY OF THE ATMOSPHERE,

(Continued from page 72.)

Very often the clouds do not discharge themselves at once; there then happen several flashes from the same clouds. This is like the successive residual discharges from a Leyden battery. The path of the flash is generally zigzag, hence the term forked lightning, probably occasioned by the resistance which the electricity meets with in passing through the air which it throws into violent agitation. It usually passes from cloud to cloud, or from a cloud to the earth, but it has been observed to pass from the earth to the cloud. This latter phenomenon is very seldom witnessed and may be thus explained. When a discharge has taken place between clouds the recoil may bring one nearer the surface of the earth, which may now be positive with regard to the cloud, so that the flash will pass into the cloud, if striking distance is attained. The longer the lightning continues the rarer the clouds become. They break at length, the sky is seen through them, and gradually they vanish. Forked lightning occurs in long flashes, generally white, but sometimes blue or violet coloured. It is considered the most distructive kind of lightning. What is called *sheet* lightning is usually seen low, in the horizon, and is said to owe its appearance to reflection of lightning below the horizon. It is harmless. Dark blue, violet, or red, are the colours of this form of lightning, which has neither the whiteness nor swiftness of the forked. *Spherical* or *ball*, lightnings are luminous masses, or fiery globes which descend slowly to the earth, are seldom seen, and constitute the most curious electric phenomenon. No satisfactory cause has been assigned for this form of lightning.

Thunder is the sound caused by the sudden displacement or dispersion of the air by the passage of the lightning flash, and the concussion which follows.

It is perceived on a small scale in the snap attending the spark from a Leyden jar. It is produced simultaneously with the lightning, but the one reaches the eye sooner than the other does the ear, because light is almost instantaneous in its passage compared to sound. Light travels at the astonishing velocity of 192000 *miles* in a second; sound at the rate of only 1130 *feet* in a second. A person in close vicinity to a thunder storm, will hear, almost at the instant in which he sees the lightning, a loud report of short duration. A person at a distance after a corresponding interval from the time he sees the flash, will hear a peculiar rolling sound, caused by the reverberating waves of air. Many peculiarities of thunder are produced by the features of the country as regards mountains, hills and valleys. Sometimes it resembles the discharge of heavy artillery, or quick discharges of musketry, or the unloading of heavy cart-loads of stones. This simple rule will enable one to determine the distance of a storm with sufficient accuracy. Note by a seconds' watch the number of seconds which elapse from the sight of the lightning to the commencement of the thunder, divide them by five, and the quotient is the distance in miles. Thus, if the thunder is heard 10 seconds after the lightning is seen, the distance will be two miles; if one minute elapse the distance will be twelve miles. The longest thunder-roll lasts only from thirty to fifty seconds.

The interval between the flash and the roll has seldom been observed greater than 72 seconds. Half-second intervals are also seldom recorded. Such an interval can only occur when a storm is merely a few hundred

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feet above or beyond an observer, and such close proximity would be highly dangerous, particularly so if he were unsurrounded by objects a great deal taller than himself.

Sometimes lightning is seen but no thunder follows. Some people think these lightnings harmless interchanges of electricity, the atmosphere seeking its electrical equilibrium. But generally it will be found that a storm has taken place too distant from the observer to admit of him hearing the thunder. Sheet lightning is the kind most frequently observed without thunder.

These thunderless summer lightnings, without storms and without dangers, are as frequent in the tropics as in the temperate regions. It may happen that lightning sometimes occurs between clouds at too great a height for the thunder to be heard; but if the simultaneous meteorological phenomena could in these cases be traced far around, it is exceedingly probable that thunder had followed the lightning, that the weather was stormy, and that danger was not absent. For it cannot be imagined that a certain law of nature can be operative, without the accompaniment of its usual results. As well imagine heat without cold, action to be unattended with reaction, or light to displace darkness.

Such then is a popular explanation of the magnificent and sublime phenomena of a thunder storm; a spectacle which makes the strongest impression upon all human beings. The learned and the ignorant are alike amazed at its grandeur. Nor is the dread of it confined to any portions of the human races. All people alike, savage or civilized, stand appalled in its presence. The creeds of savage people, and even of ancient civilized nations, assigned it to the wrath of offended deities. And if in the Bible we are told that thunder is the voice of the angry Lord, we should remember that this wonderful book abounds with metaphors and similes, and we are not to interpret such a passage literally. Yet some times we may hear a thunder-storm which has been destructive of property pronounced a retributive justice sent by the Creator. Intelligent Christians surely cannot approve of such opinions. For he who causes the sun to shine upon the evil and the good, and the rain to fall upon the just and the unjust, has also ordained the terrible thunder, the destructive lighting, and the devastating storm to be agents of good in the economy of nature.

Some regions of the earth are singularly exempt from thunder storms, particularly those where rain seldom falls. It seldom rains in Egypt, and thunder and lightning are equally rare. It very rarely rains in Peru, consequently thunder and lightning are scarcely ever witnessed. Thunder storms were very seldom seen by the Polar voyagers and travellers, and they are said never to occur at sea at a few hundred miles from land. Where there is most rain, there thunder and lightning are most frequent. They come at the same seasons. In the tropics they accompany the wet seasons and the changes of the monsoons. In the temperate regions very few thunder storms occur in winter, and only a few in the hottest days of spring and autumn; more than one half come in summer, and generally in the day. However, it is asserted that on the western coast of America, and on the eastern shores of the Adriatic, more occur in winter; in Greece, more in spring and autumn than in summer. At Kingston, in Jamaica, it thunders every day for about five consecutive months, though there is none at the adjacent islands; also at Popayan in Columbia, during a certain season, there is thunder every day.

(To be Continued.)

HOROLOGY AT THE INTERNATIONAL EXHIBITION, LONDON, 1862.

By M. BOQUILON.

Translated from Annals de Conservatoire Imperial by J. S. Harding.

Of all the kinds of products which may figure in an Exhibition, horology is, undeniably, the most difficult to appreciate, with respect to progress, which we should consider almost exclusively. To theoretical knowledge must be united a sufficiently long practice to be able, in the absence of clear and precise information furnished by the exhibitor, to study the frequent very rapid action of the instruments in use. It would be necessary above all to find each exhibitor at his stall, to question him respecting the object proposed, in employing one arrangement rather than another, in order to rest one's judgment on certain bases, instead of on mere conjectures.

If this difficulty is not altogether insurmountable with regard to timekeepers of a certain size, and of sufficiently easy access, it becomes absolute with respect to those whose mechanism is entirely hidden by the cases which envelope them.

This was true with the whole of the foreign exhibitions except France. Nowhere, not

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even among the English, have we found any person to speak to,* and we have returned from London without having been able to examine closely one single horological instrument which was not French.

Let us observe, however, that in Switzerland, information has not always been wanting, and many times it has only rested with ourselves to attest the perfect execution of the chasing, engraving, enameling, and other ornaments which enrich the cases of the watches, and the multiplicity of the indications given by certain dials. But when we came to ask the only question in which we were seriously interested;—what progress has Switzerland made since 1855, in a purely chronometric point of view,—the invariable reply was that the workmanship had considerably improved, but that nothing had been altered, as to effects produced, nor as to the instruments employed to produce them. All were almost exclusively borrowed from Parisian watches.

We will mention however, not as a novelty, but as answering to a want arising from the present conditions of locomotion, repeating watches, giving not only the quarters but even the minutes elapsed since the last quarter. These watches are now made in great numbers. We mention this fact to our manufacturers of *portable timekeepers*, called travelling or carriage clocks, which only repeat the quarters, and leave one in uncertainty as to the interval of time which has passed since the quarter announced. Many elderly persons affected by want of sleep would find a relief to their weariness, by a more precise indication of the time.

But to return,—our gathering in foreign chronometry is reduced nearly to zero, and we are obliged to fall back almost entirely upon the French exhibition of horology of which we have been able to study a few specimens before our departure, and respecting which we were able to obtain, at London more detailed information, because the jury who were then sitting called together a certain number of French exhibitors.

Let us state in the first place that, with one single exception, competition in æsthetic horology was completely wanting. It is not that the important houses in France, which fear no rivalry in this kind of industry, had disdained to be represented there, but the smallness of the spaces which were offered to them scarcely allowing them to erect their smallest model, they did wisely in abstaining in the presence of the inferior conditions which were imposed upon them. The contest, in these industrial solemnities is only acceptable on condition of being able to make use of every resource one possesses, and of space being equally divided among the champions.

In default of the greater, let us consider the smaller kind of horology, and state at the commencement those conditions which we sincerely hope will be accepted by all interested, as a progress as real as it is serious.

In portable watches or chronometers the regulator is a balance, whose alternate circular movement performs the same functions as the pendulum in fixed pieces; with the latter, it is terrestrial attraction, which, tending to restore it to a vertical position when it has deviated from it, determines in a great measure its oscillating movement; the impulse it receives from motive force, through the medium of the escapement being intended solely to renew periodically that amount of motion, which it has lost either from the resistance of the air, or from the friction of the pieces it has to disengage. Without this periodical renewal of lost force the amplitude of its oscillations would constantly decrease till it reached a state of absolute rest.

Again, if the motive force by which its lost velocity is restored should vary, the amplitude of the oscillations varies with it, the long vibration of the pendulum taking place more slowly than the short one. Hence the necessity of reducing this amplitude to a minimum, and of employing, between the motive force and the pendulum, a medium whose action is constant on the latter, which is thus dependant on the variations of the motive force, as to the impulses it receives from it, but which, except in two single instances which have come under our knowledge, are not free from it, whilst disengaging the wheelwork to restore to the medium which generally takes the name of remontoir, the repository of force which it has periodically and regularly distributed to the pendulum.

(*To be Continued.*)

* Surely the writer's mistake.

THE COVENTRY WATCHMAKERS' ASSOCIATION have forwarded a statement of the prizes which they offer for public competition this year. The first prize is £3, for the best improvement in the construction of the watch movement, or part of the movement. The second prize is £2, for the invention of a new tool, or the best improvement of a tool, at present in general use in the watch trade.

The conditions of competition are the same as stated in the notice which we printed at page 10 of this volume. The Association "claims no property in the invention or improvement, being only anxious to encourage efforts of practical value."—ED. H.J.

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METEOROLOGICAL OBSERVATIONS

Taken at 9 A.M., JANUARY, 1863.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	30·010	49	48	49	37	SW	7	mr	o,qqr
2	29·490	45	44	55	45	NW	9	o	cb, b
3	29·661	40	38	45·5	38	SSW	4	c	c,b,r
4	29·370	42·7	40·2	45	39	WSW	4	b	bc, b, r
5	29·132	46·7	45	47	42	S	6	r	rr, m
6	29·128	44	42·5	49	40	S	3	m	pomrrm
7	29·234	37	36	46	45	WSW	3	mc	cb
8	29·531	40	39	42	37	SSE	3	mc	cb, f
9	29·737	34	33	43·5	33	NE	2	f	c, r o
10	29·784	39·2	38	42	35	E	6	o	oc, rm
11	29·814	39	38	40	37	NE	3	mr	r, om
12	30·174	33	32	40	29·5	SE	1	m	f, o, rr
13	29·898	44	43·5	46	33	E	3	r	ff, o, r
14	30·228	39	38	46	36	NE	3	om	om
15	30·427	40	38	42	36·5	ENE	5	c	o, b
16	30·344	39·5	38	42	36·5	NE	4	c	o
17	30·238	39	37·5	41	35	NE	2	o	om r q
18	29·396	43·5	41·2	43·5	33	NW	6	c	bc
19	29 371	48	44	48	40·5	NW	6	bc	cb, qqcp
20	29·150	45	40·5	50	43	NW	9	cq	bcq
21	29·630	42	39	45	36	WNW	6	c	cb,bmr
22	29·780	49	47	49	41 5	SW	6	c	omr
23	29·610	51·5	48	53	48	SW	9	o	cpbq
24	29·717	46	43 5	54	40	SSW	9	c	cqq, b
25	30·200	42	39.5	51	38	W	4	b	cb, o
26	30·331	47	43	49	41	SW	4	o	ocoqqr
27	30·130	48	44	52	45	W	5	o	c, b
28	30·564	37	35	48	34	SW	1	m	m,b,oq
29	29·893	50	47·5	50	36	SW	8	oq	cbpqc
30	29·642	50	48 3	54	48	SW	4	om	or, rq
31	29·416	48·2	46·7	52	46	WSW	5	bc	r, c, b
	29 775	43·2	41·1	47·1	38·8		5	Mean.	

REMARKS.

The atmospheric pressure reached 30·564 inches of mercury at 9 a.m. 28th, and 30·547 at 3 p.m. 15th. It was as low as 28·940, at 8 p.m. 5th, during which day and the 6th, it continued remarkably low. On the 20th it was also low, being only 29·094 at 8 a.m.

The year commenced with stormy weather. The whole of January has been very boisterous and changeable. The barometer has been very unsteady as a consequence; but the temperature, on the whole, has been very mild. A constant succession of gales have occurred, accompanied with violent squalls; but with little rain. During the 1st. and 2nd., strong winds reaching to a gale, blew from between SW and NW. From 5 p.m. 12th, to 5 a.m. 13th, there was constant heavy rain; the amount being six tenths of an inch. Between 11 a.m. and noon, 13th, a dense fog suddenly enveloped London for about half an hour.

The darkness was such, that lights were in immediate requisition. From comparison of times it appears to have originated to the westward of London and travelled eastward. It dissipated the E wind, which was blowing, and left a W wind. Hence it seems to have occurred from the cooling down of the vapor of the westerly wind by the colder air of the easterly breeze; and was doubtless endebted for its intense darkness to the London smoke. The commencement of the 18th was stormy, with heavy rain, from NW. The wind continued strong till the morning of the 19th, when it again blew a gale from NNW. The whole of the 20th was very tempestuous; the wind veering from NW to WSW, with very little rain. In the morning of the 23rd a gale blew from SW. During the whole of the 24th there was a gale from S to W. At night, of the 26th, again a gale from SW. In the morning of the 29th, another swly gale; and finally on the night of the 30th, a similar gale. Such a succession of gales have of course been highly disastrous, especially to shipping; though no doubt many vessels have been opportunely retained in port by the warning signals which have been repeatedly exhibited around our coasts.

The amount of rain collected was 2·34 inches; which fell on 16 days during about 70 hours.

Refering the winds at 9 a.m. to the cardinal points they will be found to be N, 5; E, 6; S, 9; and W, 11.

Indications for March.

It may be interesting to state the chief facts which may be considered to indicate in some measure the characteristics of the weather of each month. March is the month before us, and we commence with it.

The middle day has the sun above the horizon in the latitude of London about 12 hours. The mean day temperature is 50°, the mean night 35°. The average barometer height is 29·90; which may be less or greater by about three-tenths. The prevalent winds are from N to E. About 1·5 inches of rain for the average falls on 13 days.

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THE BRITISH HOROLOGICAL INSTITUTE.

THE ANNUAL DINNER.

The Annual Festival of the Institute was held on the 9th ultimo, at the *Freemason's Tavern, Great Queen Street.* The chair was occupied by Sir Samuel Morton Peto, Bart., M.P., who was supported at the cross table by Vice-Admiral Manners, F.R.A.S., one of the jurors in the horological department of the International Exhibition; Valentine Knight, Esq., J.P., President of the Institution; Lieutenant-Colonel Penton, Commandant of the Finsbury Volunteer Rifle Corps; John Bennett, Esq., F.R.A.S.; E. D. Johnson, Esq., F.R.A.S.; W. Hislop, Esq., F.R.A.S., Honorary Secretary of the Institute; G. Blackie, Esq., Treasurer of the Institute; S. Jackson, Esq; G. Oram, Esq., and other gentlemen of eminence. The vice chairs were respectively filled by John Jones, Esq., Vice-President of the Institute; C. J. Klaftenberger, Esq., another of its Vice-Presidents; and E. J. Thompson, Esq., one of the Trustees. Amongst the other leading horologists and other gentlemen present were Messrs. Egbert Storer, H. Holland, Howard, W. B. Crisp, G. E. Mylne, Matthew Thompson, R. Haswell, Callard, Reynoldson, and Desprez.

The musical arrangements were under the direction of Mr. Glenn Wesley, assisted by Madame Gordon, Mr. A. Lester, Mr. Chaplin Harvey, and Mr. Pennington.

The Chairman, who upon rising was received with loud cheers, in proposing the health of the Queen said—"Mr. President and gentlemen, the life of a country is like that of an individual, made up of sunshine and clouds. We have, during the last year, had a great deal of the clouds, and we have now reason to hope for much of the sunshine. Her Majesty has of late had the sympathy of all her subjects excited in her behalf, in consequence of the sudden death of the Prince Consort. In proposing her health on recent occasions, it has been customary to do so with reference to the great calamity which herself and the country had sustained in the loss of a prince, the mention of whose name could not do otherwise than call up feelings of sorrow and regret. No one here present wishes to forget that inestimable personage; but, gentlemen, there are times to rejoice as well as times to weep, times to be merry as well as times to mourn, and we now feel that Her Majesty having done all that the most tender affection can suggest in reference to the memory of the late Prince Consort, has now properly turned her attention to the position of her family, and to their prospects in life. Having experienced sorrow for a long time past, we desire that the happiness which surrounded her home in days gone by may prevail again without interruption. I therefore give you, with a feeling of joy which has for some time not been associated with this toast, the health of Her Gracious Majesty the Queen."

The toast was drank with every demonstration of loyalty, and was followed by the National Anthem.

The Chairman:—"Gentlemen, my next toast is, 'The Prince of Wales and the rest of the Royal Family,' a toast which at the present moment I am sure commends itself in a greater degree than it has done upon any previous occasion, to our heartiest acceptance. On Saturday last, His Royal Highness the Prince of Wales had a reception which no one in this metropolis, nor I believe in any other, ever before had accorded to him. The occasion was indeed one which excited the deepest feeling of sympathy with Her Majesty and with the royal family, and especially her eldest son, throughout the whole country. We can only feel, and give our warmest expression to the feeling, that we fervently hope and trust that to-morrow may make the Prince of Wales the happiest of men. It so happened that a short time before the engagement of His Royal Highness to the Princess Alexandra was generally known in this country, I happened to be in Copenhagen, and at a reception I had at the court, I had the honour of a lengthened interview with Her Royal Highness. I had a long conversation with her; and I must say that I was never more struck in my life with the charming qualities of any person; it appeared to me that the beauty of her mind fully equalled the graces of person which she displayed. I cannot but feel that the Prince has been directed to make a choice auspicious in every respect, in regard to his own happiness and to that of the country at large. The education of Her Royal Highness and all the members of her family has been of the most thoroughly sound character. I may mention one little incident, which will serve to show the way in which the family of the Princess was brought up, in all the arts and accomplishments, and in everything that would tend to qualify them for the high positions they were destined to occupy, in like manner as the family of the Queen and the late Prince Consort were educated. The present King of Denmark was anxious to show his great regard for Prince Christian, and accordingly His Majesty sent for him, and offered to present the young Prince with a commission in a particular regiment distinguished for its position in the army of Denmark. Prince Christian replied—'No; my son must take his position in the army like every other young man entering its ranks; he must take it subject to an examination as to his competency, and if he fails he fails.' The young man went to work and studied for his profession, and after a time presented himself for examination, which he passed with credit to himself, and then took his ensigncy as a matter of acquired right, and not of royal favour. I saw him again some three or four months since, and at that time he had become a lieutenant. I met him on the railway from Brussels, and I found him just one of those young

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men whom you sometimes find—though not so commonly as we should like to meet with them—in conversation thoroughly well informed, well versed in the principles of science, and at the same time knowing intimately what is passing in the world, and showing a lively interest in the events of the day. I have taken the liberty to mention this circumstance in connection with this toast, because I thought it would please you. I am sure you will join me with every feeling befitting loyal subjects, in wishing the greatest possible health and happiness to the Prince of Wales and the rest of the royal family."

The toast was drank with the extraordinary demonstrations of enthusiasm, which the eve of the Prince of Wales's wedding day was likely to elicit, and was followed by the ode, "Hail to thee, Albert!"

The CHAIRMAN then rose and said:—"Gentlemen, the next toast I have to propose to you, is that of 'The Army, Navy, and Volunteers.' I am quite sure that it is not necessary for me to say one word in commending it to your acceptance. The army and navy have shown in times gone by how well they have deserved the eulogiums and rewards which they have received at the hands of their countrymen; but we have at the present time associated with these forces in the defence of the country the volunteers. The position which that body occupies at the present time, is not only such as to excite the admiration of their own countrymen, but of Europe at large. I am sure that the army, navy, and volunteers will ever be what they have been in times past in the opinion of Englishmen and the world. I am sure that you will not hesitate at the present time to testify your regard for them by drinking their healths. Coupled with the toast, I will give you the names of Vice-Admiral Manners and Lieutenant-Colonel Penton."

The toast having been drank—

VICE-ADMIRAL MANNERS rose and said:—"Sir Morton Peto and gentlemen, I beg to return thanks to you on behalf of the navy. I sincerely thank you, gentlemen, for the kind manner in which you have been pleased to respond to the toast In these days of the reconstruction of the Navy much attention has been necessarily directed to the naval service. And yet we are engaged in what I will venture to call only the early part of our work; for as yet, I believe, notwithstanding all our great improvements, that reconstruction is but in embryo. We have got a class of large iron ships, such as 'The Warrior' for instance, which class is a very good one so far as it goes; but—I am speaking of course my own individual opinion on the subject—they are not by any means such ships as we shall hereafter require to go into what will ultimately be a line of battle. To meet the advance of the age, we shall require at least three hundred pounders. You may say, gentlemen, that our requirements are great, but they will be forced upon us. I am quite sure that we shall require such guns for our line of battle ships, whether they have one, two, or three guns on board. Those which we now have of 'The Warrior' kind we shall consider as our frigate class. Besides which, when we look at the number of our colonies, and the numerous places where we have to protect our commerce, which is spread all over the world, one sees at once that it is out of the question to have heavy ships for such a purpose. It is very remarkable that we should require this light class of ships. This will bring us great expense and much trouble, and the change will need the cordial co-operation of officers and men in carrying it out; but every person in the navy feels convinced that the navy of England will turn out when so reconstructed—I trust I may say so without boasting—to be in that position of superiority which it had over other nations in olden times. Formerly ships were built to have as many sailors and as great a number of guns as possible; now they require fewer men, but the ships should be built with iron protection, or that which is tantamount to it, improved guns. Other nations no doubt will have the same requirements as ourselves; they will do the same as we do, for they are engaged in the same struggle for superiority, but they have not our aptitude; the aptitude which Britons have for naval matters will, I have no doubt, carry them through every trial. I am not now speaking of the courage of Britons, but only of the aptitude which they as a people possess in naval matters. We are however enabled to maintain our superiority as navigators chiefly through the aid afforded us by the members of that art, so many of whom I have the pleasure to see on the present occasion, and which art is here represented by the Horological Institute. I believe that the chronometer is the most wonderful invention of man, certainly it is as far as I know. I can say, as a captain of the royal navy, that I could not have performed the work I have done without the assistance of the art of horology. I have likewise to speak with gratitude of its members, from the fact of having frequently been able to repose my head upon my pillow at night, owing to the circumstance of my possessing a good chronometer, whereas if I had not had one, I should have been obliged to walk the deck all night in great discomfort. On the part of the navy, therefore, I beg to thank you, Sir Morton Peto and gentlemen, for the kind manner in which you have received the toast of 'The Army, the Navy, and the Volunteers.'"

LIEUT-COLONEL PENTON, in replying to the other points of the toast, said, "Sir Morton Peto, and Gentlemen; I was not aware when my name was coupled with the toast that I should be called upon to return thanks for the Army, as well as for the Volunteers, however, I must say that I feel it to be an unexpected honour, to be called upon to return thanks to the Army, for although I have never belonged to it, I have always had a very great taste for military matters. I therefore trust that I shall not be considered out of place, although I have never been in the Army, in returning thanks for it. I have been associated with it in other ways, and I can testify that the Army of England stands foremost all over Europe. Whenever it has been engaged it has done its duties, and the world has appreciated it as it ought to do. With regard to the Volunteers, Sir Morton Peto has kindly said that they are appreciated in every part of Europe. They have added very much to the real greatness of our country since they have risen into existence. I am sure that on an occasion of this kind, I am

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proud as commanding officer of a local corps, to find an Institution like this drinking their healths, and appreciating them in the same high manner in which they are appreciated all over the country. I trust that the manner in which the volunteers on Saturday last, received the Princess Alexandra, will be taken as a proof of their loyalty to the royal family, and of their readiness to do their duty in defence of the country. I must apologize for being an exceedingly bad speaker, I trust you will accept my return of thanks in these few brief words, expressing to you my sincere thanks for the honour you have done the Volunteers in coupling their names with those of the Army and Navy"

The Chairman,—"My next toast on the list is 'The British Horological Institute;' and I have the pleasure of coupling with that this evening the healths of Mr. Valentine Knight and Mr. John Bennett. Now gentlemen, we are all of us, more or less interested in the prosperity of that Institute, We are met now for the special purpose of promoting its success We therefore feel it to be our duty to address ourselves to that object above every other to night. I think that there can be but one feeling amongst us all, not only as to the object itself, but also as to its worthiness. We cannot but feel all of us, that we are more or less identified with its success. We know that it deserves success; we mean to make it succeed, and we must give it our heartiest efforts to enable it to do so. I do not believe myself in any thing done with half a heart, I certainly think that we must take the whole of our hearts united, to promote the success of the object of the meeting. I am sure you all know as well as I do, that this institute has peculiar claims upon the members of the horological art, as well as those who are not connected with it. I quite feel that in connection with any particular trade or business in this country, association is one of the best means of promoting its success. But I regard the Horological Institute, as one which has to do with a very high class of art, as well as a high class of business, and therefore find that association of its members is particularly necessary. It has to do with mechanism of a very exquisite character, of the highest possible class, in which some of the most able and glorious men have taken the greatest possible delight, and I know that it has been their association with this mechanism, which has been the main spring, if I may use the expression, and the means of development of their success in other scientific departments: that from which they have derived their great success in mechanical arts. A single fact with regard to an eminent engineer of our own time will serve to shew that many of the greatest results in mechanical invention have sprung from a study of the principles of watch machinery. I was well acquainted with the late George Stephenson. You will find in *Smile's Lives of Engineers* this very fact stated in regard to that eminent man, namely, that he received his first impulse to the study of mechanism from having in early life been engaged in making and mending watches. He has, moreover, himself told me in conversation, that he traced a great deal of his idea of the locomotive, and all that sprang out of it, to his love for the watch, and to his early association with its mechanism. My gallant friend to the right. Vice-Admiral Manners, who is an eminent member of the Royal Astronomical Society, has told us how very useful he found a good chronometer on board ship; I might ask him what the Astronomical Society would have done without the assistance of the professors of the horological art? Would it have made the great discoveries it has made without them? certainly not. It is impossible to pursue one branch of knowledge without its bringing us into association with a number of others. It is this which gives those who are not connected with this institution an interest in it. We feel that we are identified with it in these important particulars; we feel that the success of the Institute is identified very much with the well being of the country. Therefore I take common ground, and ask all of you to join me in doing all you possibly can to make this institution a success. I began by saying that in order to make it a success it must have no half-hearted support. At the present moment you as watchmakers are brought, and very properly so, into competition with the world as watchmakers, and if England is to maintain her high position in the art of horology, it must be by keeping ahead of the rest of the world. I believe that Englishmen will never be left behind in this or any other matter of competition. It is with this conviction, therefore, that I propose this toast, first asking you to drink to the prosperity of the British Horological Institute, and then calling upon you afterwards to shew, in a more tangible way, your desire and determination that it shall be a success."

The toast was drank with the greatest enthusiasm.

Mr. Valentine Knight:—"I am sure, gentlemen, that you will believe me when I say that I always have felt and ever shall feel the deepest interest in the success of this society. I am delighted to have heard the remark made by the honourable and gallant admiral on my right, who has told us that if it had not been for a good chronometer he must often have walked the deck all night instead of reposing on his pillow as he did do. But gentlemen, we know that if it were not for a good watch many persons in other branches of life would have to walk the deck all day. I do not know what would become of them or where they would be, but for the use of that little instrument. It certainly is, and always has been, a grievance to me that this Institution should not have been more generally understood and more extensively patronized than it has been. I was going almost to say that it was a disgrace to human nature that this Institution should not have been more extensively supported than it has been. I trust that the time will come when every man who wears a watch will appreciate its value, and feel that he is bound in duty to step forward and help the members of the trade by which it is manufactured. Of the watch Sir Morton Peto has very happily said that he believes it to be the main-spring of all the great mechanical inventions of modern times; that he is of opinion that all these great mechanical improvements have sprung from the idea of the mechanism of the watch. I almost question whether we should have had the development of the great talents of our excellent Chairman himself if it had not been for the watch,

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because as he has told us to-night he believes that the invention of that wonderful instrument the steam engine was suggested to the mind of George Stephenson by a study of the construction of watches. But I will say no more at present. You have listened to me for so many years upon the same topic, that I am sure you will believe me when I say, that I wish the greatest possible success to the Horological Institute."

(To be Continued.)

The following List of Subscriptions was announced in the course of the evening :—

	£	s.	d.
Sir S. Morton Peto, M.P.	10	10	0
Valentine Knight Esq.,	10	10	0
W. G. Lettsom, Esq.	10	10	0
Lieut. Col. Penton	5	5	0
John Bennett, Esq.	5	5	0
E. D. Johnson, Esq.	5	5	0
John Jones, Esq.	5	5	0
Samuel Jackson, Esq.	3	3	0
E. J. Thompson, Esq.	2	2	0
C. J. Klaftenberger, Esq	2	2	0
T. Reynoldson, Esq.	2	2	0
Thomas Leonard, Esq.	2	2	0
Mr. W. Crowther	1	1	0
„ G. J. Oram	1	1	0
„ H. Holland	1	1	0
„ H. Ehnhuus	1	1	0
„ G. E. Mylne	1	1	0
„ F. W. Knight	1	1	0
Mr. F. R. Warman	1	1	0
„ C. Guillaume	1	1	0
„ W. Callard	1	1	0
„ Geo. Blackie	1	1	0
„ Luke Hancock	1	1	0
„ J. Neal	1	0	0
„ Chas. Desprez	0	10	6
„ J. L. Tilling	0	10	6
„ Chas. White	0	10	6
„ R. Howard	0	10	6
„ R. Haswell	0	10	6
„ H. J. Moore	0	10	6
„ A. Klaftenberger	0	10	6
„ E. Klattenberger	0	10	6
„ G. H. Werner	0	10	6
„ W. G. Schoof	0	10	6
„ J. Turvey	0	10	6
„ Thos. Mercer	0	10	0
Mr. S. Holdsworth	0	10	0
„ Victor Kullberg	0	10	0
„ B. Sitch	0	10	0
„ A. W. Dornburg	0	10	0
„ F. Lecluse	0	10	0
„ E. Storer	0	10	0
„ W. S. Mourgue	0	10	0
„ H. Richards	0	10	0
„ W. B. Crisp	0	10	0
„ R. Rolfe	0	5	0
„ — Neville	0	5	0
„ H. Palmer	0	5	0
„ G. Lee	0	5	0
„ A. Straiton	0	5	0
„ T. W. Holdstock	0	5	0
„ Mark Stevens	0	5	0
Total Amount	£89	2	6

HOROLOGY AT THE INTERNATIONAL EXHIBITION, LONDON, 1862.

By M. BOQUILLON.

Translated from Annales du Conservatoire Impérial by J. S. Harding.

(Continued from page 85.)

It is not altogether the same with the circular alternating balance, where the attractive force of the earth is replaced by the elasticity of a spring, which, in watches, takes the form of a volute; in chronometers, that of a cylindrical spiral of which one of the extremities is fixed to the axis of the balance and the other on a fixed point of the watch or chronometer.

In both cases, the conditions of the spring's action, for each double oscillation of the balance, allow alternately an augmentation of the diameter, either of the flat spiral, or of the cylindrical spiral; in other terms, first a removal of each of the spires from the axis of the balance; then a compression of the spring by which the spires draw nearer to this axis.

It is understood, as in the case of the pendulum, that the magnitude of the arcs travelled over, would decrease constantly to a state of absolute rest, if the motive force of the watch or chronometer did not restore periodically to the balance the amount of motion that it loses at each oscillation.

Whatever precaution is taken, the motive force which resides in a spring—the starting point of the motion imparted to all the moveable parts of the instrument—is necessarily variable in its intensity, whence it results that the amplitude of the oscillations of the balance vary with the variations of the motive force. This variation in the amplitude of the arcs of the balance is, as in the case of the pendulum, a cause of variation in the deviation of the oscillations. Huyghens has destroyed this disturbing cause, by making the pendulum swing in the cycloidal arc. This object is more conveniently attained by weakening the motive force in such a manner that the pendulum makes only very small arcs; the small arcs of a circle blending sensibly with the arcs of a cycloid of the same size.

It is understood that this cannot be the case with respect to balances, which require, on the contrary, very large arcs, which a long practice has considered preferable to small ones.

Pierre Leroé was the first to make known, more practically than theoretically, the possibility of the isochronism of the spiral, that is, of a similar duration of term for large and small arcs. Berthoud has only given some empirical rules on this subject, applying very well to instruments of his own manufacture. The same investigation among clockmakers who have gained some reputation in chronometry has led them to similar results.

To be the pupil of a good master, to imitate with the most scrupulous care the operations which he puts into practice, has been, hitherto, the rule adopted in the manufacture of balance springs, more or less isochronous.

In 1861, the *"Annales des mines"* published a memoir of M. Phillips, a mining engineer, upon the spiral spring regulating chronometers or watches, a memoir in which the author establishes the analytical theory

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of this important element. But this work is far from being within the reach of practitioners, and would probably have remained unknown to all, if the author had not communicated it to the *Societé des Arts and Metiers*, which published in the number of their transactions for November 1861, an extract more easy to understand. He there announces that all the theoretical conditions resulting from his labour have been carefully subjected to a series of experiments which have all given results conformable to his theory. Among the instruments exhibited by M. Phillips, are specimens large enough to verify, with the worst view of the case, the results announced, of which we are quite convinced. We have learnt moreover with great interest that a certain number of heads of houses intend to experiment on the application of them to their own timepieces, and that, already, conclusive results have been obtained by M. Dumas, of Dieppe.

We regret that we have not sufficient space to acquaint our readers with the considerations by means of which M. Phillips has attained the long sought for end, and must limit ourselves to the summary,—perhaps too succinct—of the conditions to be fulfilled.

One remarkable fact derived from the experiments of M. Phillips, apart from the question of isochronism, is this;—

The deviation of the vibrations of the spiral spring is, all other things being equal, proportional to the square root of its length developed, which assimilates it completely to the pendulum, notwithstanding the difference which may be called radical, either between the bodies in motion, or the forces which put them in motion.

Among the conditions to be accomplished, two are fundamental and require:

1st. That the centre of gravity of the entire spiral spring should be on the axis of the balance, and remain there constantly during the motion.

2nd. That the spiral spring should exercise during its action, no lateral effort against the pivots of the balance; in other terms, and especially with respect to the cylindrical spiral spring, that this spiral during its action should always expand and close very concentrically to the axis.

These conditions depend on the form of the terminal curves of the spiral spring, a form of which M. Phillips has given the law. These curves may present a very great variety of different forms, which will all satisfy the conditions mentioned.

Other advantages result from the employment of the spiral springs constructed according to this law. The absence of all pressure against the axis of the balance realises the free spiral spring, that is one in which this axis, being subjected to no pressure, is independent as much as possible of the friction and variations of the spring, resulting from the coagulation of oils; the spiral spring always expanding and closing very concentrically to the axis instead of being thrown on one side and the other, as is generally the case, the disturbance produced by the inertia of the spiral spring is avoided.

As to the flat spiral springs of watches, the conclusions of the author are that isochronism can only be satisfied by small arcs of oscillation. However, better results are obtained with the flat spiral spring called *ramené* whose small portion, which corresponds to its fixed extremity, terminates in the form of a curve drawn back nearer to the centre, and whose object is to develope the spirals more concentrically to the axis.

The instruments destined for demonstration, which figure at the exhibition, have been executed with a skill quite remarkable, some by M. P. Garnier, others by M. Rose.

The latter has moreover, invented certain conditions of manufacture, temper, and annealing, the efficiency of which he asserts to be perfectly sure, but of which, as he has a right to do, he still keeps the secret.

The most ancient of the watchmaking establishments which figure in the French galleries is that of *Breguet* which notwithstanding the *ondit* of certain competitors, has never ceased for an instant to manufacture horological instruments with the same skill and same success as its founder, whose grandson, M. L. Breguet, bears honourably the venerable name, by the precision of his marine chronometers, or by the originality of fancy articles, which so to speak, he still monopolises; or lastly, for the varied richness and good taste with which these same articles are ornamented.

Amateurs of these kinds of curiosities have become rare; and the superintendence required in their good execution by the artistes, apprentices in the house, has not been so incessant, as to have satisfied the activity which characterises M. L. Breguet. Without in any way abandoning the inheritance which has been transmitted to him, on the traditional conditions of the establishment, he has been able to apply himself to works of another class, and to contribute efficiently to the establishment of the electric telegraph in the whole world, either by the invention of special apparatus, or in the skilful execution of the numerous apparati which at present dispute the telegraphic

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domain; for as soon as any new condition appears with a chance of future success, M. L. Breguet hastens to obtain from the inventor the right of applying it, in order to satisfy all the exigencies, and more, all the caprices of governments, or of railway companies, who apply to him.

But let us return to Chronometry properly so called.

His exhibition, in this department, is composed of an assortment of watches manufactured of every kind, either in his workshops, or from his designs, and are recommended not only by the richness, good taste, and originality of the work apparent, but also by the perfect execution of the internal mechanism. We will select two of them as specimens; one is a pocket chronometer with calendars of dates, months, and days of the week, set to the time by the button of the pendant; the calendar set from the exterior of the case. The mechanism of the calendar is not in communication with the wheelwork for more than three minutes, and the hands move simultaneously. As soon as the shift is made this mechanism is entirely disengaged from the movement of the watch, whose hands may be turned backwards without shifting the calendar.

In all watches with calendars the two mechanisms are in direct and constant connection at least during many hours, in the most advantageous arrangements, which notably affects the going of the watch. In the arrangement of which we have just spoken this inconvenience is greatly diminished, if not entirely avoided. Let us add that it is the cannon pinion which moves the calendar, instead of this effect being produced by the hour wheel as has been the case up to the present time.

We believe this arrangement to be new; it appears to us to contain a principle which may find other useful applications in horology.

The second specimen which we will consider is a keyless watch with anchor escapement. For more than 30 years the house of Breguet has kept to the same principle of re-winding for watches, whilst constantly improving it, with respect to its application. The teeth of the wheels are very fine and set into each other deeply. The arrangement of the teeth-work allows three teeth in contact at once, and only commences at two degrees at the most, before the line of the centres. The angle pinion of the keyless work, fixed to the stem of the pendant, engages directly with the wheel of the re-winder. It is executed by an altogether special mechanical process, by which its diameter, the number of its teeth, and their angle are directly obtained.

The escapement allows of proportions different from those which are generally given to anchor escapements; it is smaller, the planes of rest of the anchor are of shorter duration, the lockings are much weaker; the balance although smaller is heavier. The plane of impulsion is entirely on the teeth of the escapement wheel, and each jewelled pallet of the anchor carries a reservoir of oil in which the tooth of the escapement wheel passes at each vibration.

The total swing is 42°, and the impulsion or real swing is 36°. Out of seven turns which the motive spring possesses, four only are made use of, which prevents all striking the bankings.

The results furnished by several watches provided with this escapement have been very remarkable; one of them, carried by its owner, and regulated each week, during four months, only showed a difference of 30 seconds from a regulator perfectly set, and that without having given any variations in its diurnal rate.

M. Achille Brocot is the happy maintainer of the honourable reputation gained in commercial horology by his father, to whom we are indebted for an escapement now become common, under the name of Brocot's escapement, and an arrangement of suspension of the pendulum, not less known among clockmakers, who employ annually more than 50,000 of Brocot's suspensions.

M. Achille Brocot has long been known in the same career as his father, by happy suggestions which have been put in the form of new escapements, visible outside, with calendars, lunations, &c., accomplishing the period of their movement with a precision which has not hitherto been obtained.

Now M. A. Brocot presents himself at the Exhibition of 1862, with arrangements no less ingenious, attaining the same ends with a precision much greater still. We will mention, firstly, an escapement of that kind called free or detached, because the impulsion once given, the pendulum becomes *free*, that is to say, without any communication with the wheelwork, until the moment when, disengaging the latter, it receives from it a fresh impulsion.

It is of the kind called "à coup perdu," because the pendulum only receives impulsion on one side, and after having made two oscillations to and from, which allows the second to be marked in chimney-piece clocks, the length of whose pendulum only gives the half second. This pendulum presents, besides, an original particularity, in that the pendulum only receives impulsion when the wheelwork is checked, and that

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the double oscillation takes place with an entire independence of the wheelwork, until the moment when the pendulum disengages the latter, so that the impulsive force is always constant. However, this arrangement is still subject, but in very attenuated limits, to the variations of the motive force, which, pressing more or less on the detent, renders variable the effort made by the pendulum to effect the freedom of the wheelwork.

We deeply regret that the space allotted to us does not allow of our giving greater detail to this truly original mechanism.

(*To be Continued.*)

Correspondence.

KULLBERG'S NEW BALANCES.

To the Editor of the HOROLOGICAL JOURNAL.

SIR,—In the description of my balances in the last number, it was stated that the balance had horizontal flat rims, "*yet*" obtained sufficient inclination action. This is not exactly describing the principle according to my views; because by having the laminæ horizontally flat, *greater* action is obtained than by any other arrangement at present known. The inclination, or rather auxiliary action, decreases as the rims approach in shape the ordinary upright laminæ.

The following is a description of the illustrations, *vide* p. 80:—The centre bar A has the brass on the top and steel underneath; the circular bar B has steel on the top and the brass underneath; C C are the compensating weights, and D D the timing screws. The weights are raised or lowered by screws for adjusting the compensation, and of course by that means with great nicety. It will be seen from the drawing that great length of laminæ is obtained by this simple arrangement. My hollow rimmed balance I consider the more important, on account of the "*great simplicity and remarkable solidity*" it possesses.

Believing that anything relating to improvements in chronometers is acceptable,

I remain, &c.,

V. KULLBERG.

To the Editor of the HOROLOGICAL JOURNAL.

Sir,—I shall feel obliged if you will insert the following, in explanation of the clerical errors that appeared in the description of Chronometers, exhibited by me. In place of "a one day marine chronometer," it should have been "one eight day marine chronometer;" again in the 34th line instead of "tightly" the word "lightly," and also the words this auxiliary adds a greater error to the balance which has to be compensated for.

I am, &c.

W. B. Crisp.

METEOROLOGICAL OBSERVATIONS

Taken at 9 A.M., FEBRUARY, 1863.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F. and mean sea level	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	°	°	°	°				
1	29·809	45	43	50	37 5	SSW	5	om	rq. cb
2	29 952	48	44·5	48	41	SW	4	om	r, bm
3	29 775	48	47	49 5	46	SW	2	m	cr, b
4	30·232	38	36	50	35	SW	2	c	c. qqr
5	30·160	46·5	43	49	37	WNW	3	o	bc. bm
6	30·320	49	48	50	46	W	2	o	om.bm
7	30·244	49	48	50·5	46	W	2	o	cb. b
8	30·040	44	43	53	42	WNW	3	r	cb, b
9	30·202	35	33	47	33·5	NW	2	bc	bc
10	30·204	43	41	44	34	W	4	o	o, b
11	30·260	45	43	48·5	43	SW	3	om	o, cb r
12	30·345	44	42	49	41	N	1	m	o, bc, b
13	30·656	35	33	49	34	NE	1	m	m, b
14	30·667	40	38	46	34	ESE	3	cb	b
15	30·620	35	33 5	44 5	37	E	2	b	b
16	30·651	32	31	45	29·3	E	1	f	m. b
17	30·657	30·5	30	44	28	Calm.	0	f	b
18	30·547	31	30	48	28·5	WSW	2	f	m. c, rf
19	30·431	42·5	41 5	47·5	31	NW	1	rf	ffr, om
20	30·422	41	40	44	39	ENE	2	om	om, f
21	30·390	37	36·5	44	34	SE	1	f	m c, b
22	30·280	41	39 5	48	36	N	2	b	bc
23	30·390	39·5	38	48	36	W	2	bc	cb, om
24	30·343	46	45	48	38	NE	2	o	omr, f
25	30·450	42	40	47	36	SW	3	om	o
26	30·436	45	41	48·5	41	SW	4	o	o
27	30·332	47	42.5	49	44	W	3	o	bc, b
28	30·301	40	39·7	54	35	Calm	0	ff	bc. b
	30 326	41·4	39·7	48	37·2		2·2		Mean.

REMARKS.

The greatest atmospheric pressure was 30·69 at midnight 13th, and the lowest 29·77 at 8 a.m. 3rd; the extreme range was therefore 0·92 inch.

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The barometer has been remarkably steady and high; the temperature several degrees above the average, and the weather quite unseasonably mild and fine, with only eight frosty nights, thick fogs occasionally, amounting to above a duration of 24 hours; very little rain; and the force of the wind reached a strong gale only on the 4th. Between the 12th and 25th, the wind veered three times round the compass from W to N, E, S to W each time.

Rain fell on 9 days, during about 34 hours, and only 0·52 inch, was collected by the gage.

According to the 9 a.m. observations the wind has blown from the N on 5 days; E, 5; S, 5; and W, 11.

Indications for April.

In the latitude of London the sun is above the horizon, in the middle of the month, nearly 14 hours. Mean barometric pressure 29·92, with a range of from an inch to an inch and a half; average temperature of the day 57°, of the night 39°; average rain-fall 1·6 inches on 14 days; the winds most prevalent are from N to E.

British Horological Institute.

LIST OF NEW MEMBERS.

Mr. George Oram, 19, Wilmington Square, W. C.
„ W. A. Mewes, 12, John Street, Minories, E.C.
„ Alfred Rowlands, 35, Meredith Street, Clerkenwell.
„ James Gowland, 52, London-wall, E.C.
„ Palmer, Wynyatt Street, Clerkenwell.
„ Robert, W., Goddard, 61, Packington Street, Islington.
„ Thomas Lycett, St. Paul Street, New North Road.
„ Robert Howard, 29, King Square. Clerkenwell.
„ R. Hopwood, Bridgenorth, Shropshire.
„ Mark Stevens, Jun., 31, Myddelton Street.
„ J. Turvey, Amwell Street, W.C.
Sir Samuel Morton Peto, M.P., 9, Great George Street, Westminster—Founder.
Lieut.-Col. Penton, Mecklenburgh Square, Life member.

Obituary.

Mr. COOPER, of *Calthorpe Street, W.C.*, died on the 8th ultimo. He was one of the oldest manufacturers in the watch trade. He was deservedly in high repute for the excellence of his productions, and his name stood at the top of the list in America.

Mr. W. CONNELL, of *Cheapside*, chronometer maker, died at his residence, *West Hackney*, on the 16th ultimo. He was under 60 years of age; was a common councilman of the City of London, and might fairly have aspired to the highest civic honours. He was a man of great ability, and no one was more respected throughout the trade.

CONVERSATION MEETINGS have been held at the rooms of the Institute during the past two months, on each Thursday evening, and will be continued. We invite the attention of our members to these meetings, as we are persuaded that much instruction and information may thus be given and received, if they are properly conducted. They have been attended by an average of fifteen members hitherto, who appear to take much interest in the scheme, which seems to promise well.

ERRATA.

In last Number.

Page 75, second half, line 18; *less* fractions, instead of *best* fractions.
Page 76, first half, line 17 from below; 4—6 degrees, instead of 4,6 degrees.
Page 77, first half, line 20 from below, *movement* instead of *measurement*.
Page 77, second half, line 7, from below $\frac{b}{\cos A}$ instead of $\frac{b}{\cos}$ A.
Page 78, first half, line 3, under the diagram A=5,5° instead of A=58°
Page 78, first half, line 19, from below; $\frac{0,384}{0,096}$ instead of $\frac{0,386}{0,096}$
Page 78, first half, line 16, from below, 4. X 0,995 } A multiplication, instead of 4,0,995.
Page 78, first half, line 15, from below, cos A′ instead of cost A′
Page 79, first half, line 17, from below, *circumference* instead of *diameter*.

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THE BRITISH HOROLOGICAL INSTITUTE.

THE ANNUAL DINNER.

(*Continued from page* 90.)

Mr. JOHN BENNETT:—"Mr. Chairman and brother Watchmakers. It has been one of the duties in which I have very much delighted, to take part in business such as that which we have assembled to-night to transact. I do not know why, with such men as are present, gentlemen of such high reputation in the horological art, I should be called upon to respond to the toast of 'Prosperity to the Horological Institute.' It is not the first occasion on which I have had the pleasure of expressing my views of the value and imperative necessity of associations for the cultivation of horological science. Years and years ago I tried—as many others did also, some of whom are present now—to make certain changes in the watch manufacture, which I then believed to be essential to the prosperity of the trade. I took a watch made by other men elsewhere—and there are some present connected with the families of those who did the same—such an one as we considered was a fair model for the purpose, and we did our best to produce the same thing in the same commercial manner as those other men had done. We found upon a comparison of our own work and what they were doing that we were very far short of them in the production of useful watches adapted to the means of the great bulk of the people. We treated the matter commercially, and in the course of my enquiries matters came before my eyes bearing on this question which were of great importance. We treated it not in a dilletanti manner—not as a mere matter to talk over, or as a simple subject of curiosity, but as a question of vital importance to the watchmakers of this country if they would live as a trade. I knew perfectly well years ago, from the small number of watches which were stamped, that our manufacture had fallen off. In 1855 it was 187,000, the largest number stamped in England, but three or four years ago the number stamped was less than 120,000. There was no sufficient reason given for this serious falling off. With other members of the trade—including some of the most thoughtful men amongst us—I then tried to crack this nut, and to solve this which we found to be to us, as manufacturers, the most vital problem. Upon examination we found that one of the secrets of the success of our foreign rivals was the fact that throughout the whole of the watchmaking districts, they have not only in every great town, but in every little village, a Horological Institute. In fact we found that every school was a Horological Institute. Their principle was, 'Catch the people in their first youth; teach them to think and reason. Try and make a man of the child, and begin by giving it the principles of that science through which in after life it will have to get its livelihood.' I have often taken the liberty of calling the attention of the members of the watchmaking trade to this very important subject. I have on many occasions had the indulgence of the gentlemen who now surround me, who have kindly listened to me whilst I have treated upon this question. I pointed out to them the need of a Horological Institute in this country and at length one was founded in this metropolis; but the wonder was not that it had at last been established, but that it had been so late in coming into existence. The matter of astonishment to me is, not that the Institute does exist, but that it required such a long time to bring home to the minds of some of the best, wisest, and most enterprising men engaged in the manufacture, the necessity for its existence. The surprise to my mind even more is, after it has been working for five years, that it should only number three hundred members. I have read, and heard it said, that the fewer the men engaged in a goodly undertaking the greater the amount of honour which must fall to each. This is all very well, but it does not account for the apathy shewn by those most interested in the subject. One reason why the value of the Institute is not sufficiently appreciated is, because we as members of the trade do not understand its necessity as a means of inculcating the principles of the sciences upon the cultivation of which the prosperity of the trade is dependent. One reason why our success as a trade has not been greater than it has been is, the superiority of our foreign competitors over us in educational institutions. I will give you the result of two circumstances which occurred to me some few years ago. On my going through the Jura, among the watchmakers residing there, I found myself in the centre of a district where the two facts I referred to pressed themselves very much upon my mind. In the district of which Neufchatel is the centre, I saw twenty thousand women employed in the trade at their own homes, and a million and a half of watches were produced in this district in the year 1855. I was there during the "Tir Federal." I advise you all to go there, because you can get there for nothing, and you will enjoy yourself in that country very much. You will see something there which will astonish you. You will not only find good shooting, but capital watchmaking into the bargain. Such was the state of the art of horology there ten years ago, that they had schools established in all directions, and instruction in them was a necessity imposed on the inhabitants by the law of the state. Education was compulsory, and at the same time gratuitous and therefore universal. It was only when they did not learn that the parents were fined two-pence a day. Non-attendance was treated as an offence against law. After a week's absence, the father was cited before a magistrate to answer for the neglect. The father who did not bring up his son as a good watchmaker was treated as a humbug; a fellow who was not fit to be a citizen of a watch-making state. Young men were incited not only to do their work cheaply, but to do it in the best possible way. Their principle is

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to produce the maximum of value at the minimum of cost. Watch making there, is no child's play; it is science in earnest, in all its branches. The place where these people live is three thousand feet above the level of the sea, one of the highest of a mountain range. It sometimes happens that the children cannot go to the schools during the severe winter months; but their education is not stopped on that account, for the schools are then brought to them; and they are taught at home during such intervals. Teaching is thus going on all the year round; in summer in schools at a distance, and in winter at home. There are no idle men there. If we in this country would prosper as manufacturers we must have regard to the improvement of our art. We cannot stand still; unless we advance we must go back. That was the state of things in Switzerland many years ago, they were doing then what we are doing now, namely meeting together with an earnest purpose, to promote the interest of an association, the object of which is to improve. I was almost going to say 'save' the trade. These Swiss manufacturers met together as earnestly, and as good temperedly as we are doing now, and with a determination of purpose that was quite astonishing. They said 'what we want is more science, more instruction in early life, better schools.' They had at that time admirable schools in existence; but still they declared that they were not good enough for them; they must have better ones yet. These men assembled around a table, and determined upon an outlay to the extent of £20,000, of which the state paid two-thirds, to found a new institution in which their children should receive better instructions than they had done heretofore. I went there some years afterwards, when this institution was in operation, and I there saw eight hundred boys and girls receiving instruction in watch making. Hence they were sucking in the first elements of horological science from the earliest years of their childhood. What will the result of all this be? Why that in the next generation our children will have very much more to do to keep pace with these foreign competitors than their fathers have had to do. One of the results of this attention of the Swiss to the improvement of horological science was, in 1861 the number of cases stamped in the Metropolis was 61,000; but last year it had fallen to 53,900 odd. In the midst of all the depression that we endured during last year, when we had nothing but suffering in Lancashire and elsewhere arising out of the American difficulty, when the people of the northern and southern states were fighting, instead of buying watches, whilst we had gone down in number, they had stamped more than ever they had done. They improved in the midst of all the trouble that we suffered. Does not that say much in their favour? This shows that their principle was right. They took the bull by the horns. They made their workmen cultivate science and so enabled them to do their work in the best manner, and to produce just that article which the world will buy. Now these are important facts for English watchmakers to consider. I point them to the Swiss watchmakers, and say, 'Go thou, and do likewise.' Begin by founding schools and horological institutions, wherein the young may in early life have opportunities of studying the principles of science in relation to the art of horology, and so be enabled to do better, and more work than they have heretofore done. In this manner you will increase the number of consumers of the articles you produce, and put every working man in a position to become a purchaser of a watch. I think that I have said enough to show you that I can well respond to the toast with which you have done me the honour to connect my name, of 'Prosperity to the Horological Institute.' I believe, however, that I have been doing what I ought not to have done. The simple business assigned to me was to do that which the learned President of the Institute could not do, namely, to propose the healths of the President, Vice-Presidents, and Officers of the Horological Institute. Its success must depend first upon the appreciation shewn for it by the members of the trade, and next upon the way in which its interests are promoted by its council and officers. I have great pleasure in proposing the toast which has thus been entrusted to me. We have amongst us to-night, gentlemen to whom we are very much indebted for the way in which they have strengthened the interests of the Institute. We are bound to give honour to whom honour is due. The Institute, upon which so much of the success of our manufacture ought to depend, owes much to the energy, exertion, intelligence, and skill of its President, Vice-President, and Officers, whose healths I therefore now call upon you to drink with the utmost cordiality."

The toast was drank with loud applause.

Mr. VALENTINE KNIGHT: — "My excellent friend who has just sat down has been, by his speech, teaching the young idea how to shoot, but as I am an old man I would rather he would have let me alone a few minutes. I am always ready to do anything I can to further the interests of the Institute, all I can do now is sincerely to thank you for drinking my health. I can only repeat what I have said before, that the prosperity of the Institute lies at the bottom of my heart."

Mr. JOHN JONES:—"Mr. Chairman and Gentlemen, I suppose I have been selected to speak to the toast upon the principle which prevails in some societies that the youngest officer has to do certain work. I happen to be the youngest Vice-President, and therefore upon that principle I am selected to perform this duty. I beg therefore, on the part of those gentlemen who are included in the toast, to thank you, sir, and the company, for the kind notice you have taken of us in our several positions as Vice-Presidents and officers of the Institute. We are conscious and so is the whole of this meeting, as much so as the last speaker but one, that in order to have progress there must be organization. There must be organization for society, for its government, and for the progress of thought also. There must be organization, for without it it is impossible to direct the minds of men to those thoughts which arise when a body of men direct their attention specially to one particular subject. It is a law of our being that when a body of men of ordinary intelligence, are directing their thoughts to a particular subject year after year, that one or other becomes an instrument of good, for communicating to mankind some further

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insight into those subjects on which they are all exercising their attention. Such fertility of thought, unless there be means of communicating at once that new light to all the rest of society, becomes in a manner lost; and, therefore, the value of organization is, that so soon as any new idea is originated, the officers of that society shall at once be able to communicate it to all the constituent members of the body. It is then with that view that we have accepted the offices of President, Vice-President, and Council of this Institute. We know that organization is necessary not merely that thoughts may be prompted and stimulated, because the emulation that belongs to men meeting together who are accessible to all the impulses that act upon the minds of men—the emulation of those who desire to stand well in the estimation of those who are competent to judge—we know is one of the strongest influences for stimulating thought; but it is also necessary that they should communicate information, in order that others shall be prevented from wasting their time on subjects and in directions which have already been travelled over by those who have gone before. Therefore it is the purpose of such institutions, and it is the duty of their officers, as soon as they can, by all means, and as one of them, to publish in their journal a record of their doings, so as to guard those who are directing their thoughts in a manner which is superfluous, and to direct them into other currents in which they may become useful to society. I think that the Horological Institute has done much in this direction, and that it has done great good in this way during the time it has been in existence. Although I agree with a good deal which has been said by one of the speakers who preceded me, although I coincide in his opinion that there has not been so large an amount of watches manufactured in this country as there ought to have been, yet I think that he would have done better justice to the watchmakers of Clerkenwell if he had at the same time stated the fact that the quantity of valuable products which leave that district, the great seat of the manufacture of watches and chronometers of the best description, if their numbers may not be so great, yet their mercantile value differs very little from the mercantile value of the multitudes which we are told leave the whole of the Swiss districts. (Cheers.) Although we have not established schools which should teach the highest departments of philosophy to children of some five or seven years of age; although we have not those schools which effect to determine, no matter what the lad's natural ability, that he shall from his earliest entrance into life follow a particular craft, we nevertheless have no need to be sorry on that account. I thank God that it is so; and that we allow our children to arrive at something like years of discretion before we call upon them to choose whether they will be engineers, ironmongers, mechanics, or fiddlers, or anything else. We do not determine from infancy that the working people in any particular district in England should become watchmakers, yet we may claim to have established this reputation, that the whole world, no matter that we have no schools of the description which have been so graphically described to us to-night, I say we may claim it as an admitted fact, that the whole world has hitherto been indebted to the English watchmakers for almost all the advancement which has been made in the horological art. Whatever there is going forward—and there is much—in the present day, of excellence and improvement in the horological art, the credit of it is due to the Clerkenwell watchmakers. I agree with Mr Bennett in all he said but this one matter. It appears to me that the British Horological Institute should be better understood and more appreciated by society than it has been. It is capable of doing and does do great service to society, but it yet does not receive that support which it is entitled to receive; although I make no complaints on that ground. We do not receive an adequate remuneration for our labour, compared with the vast amount of thought, pains, and nervous exertion which the horological art demands from its members. Sir, as watch manufacturers, we have to deal not merely with the mechanical forces, but with the imponderable forces of nature, which are among the instruments which we employ; those are the agents which we subordinate to the service of mankind—the imponderable force of heat, the imponderable force of attraction and elasticity, the imponderable force of the spring—these are the domain into which the watchmakers have to enter, with much weariness of the brain, and with only but slight glimpses into that vast forest of wisdom which lies beyond them. These are not subjects for school boys; these are not matters which children can be taught. These are subjects for the study and examination of great philosophers, and there is only here and there a man on God's earth, who is able to reach to any height in their attainment. The President, Vice-Presidents and Council have to thank you, gentlemen, for the honour you have done them in the toast you have just drank. We beg respectfully to acknowledge that honour. I feel it to be a privilege to belong to a class of men distinguished by such abilities as those which are possessed by the British watchmakers. I feel it an honour to have been elected to the position of one of your Vice-Presidents without the slightest solicitation on my part, by your unpurchasable and unbiassed suffrages. Myself and colleagues will endeavour to shew our appreciation of the favours you have conferred upon us by promoting the welfare of the Institute to the utmost extent of our power."

Mr. VALENTINE KNIGHT:—"Gentlemen, in the drama of the stage, as well as in the drama of life, there are characters which play of themselves. It happens to be my fortunate position now to appear in a character that has played of itself. I am quite sure, gentlemen, that you are as I am, delighted to see our excellent friend, the member for Finsbury, in the chair to day. (Cheers.) I do not know whether you agree with me in the qualifications which a man should possess to entitle him to become a representative of the important borough of Finsbury. I am sure that you will all agree with me, that in the first place, he should be a sincere patriot. I am quite sure you will all agree with me that he should be an individual who has shown himself to be a man of inflexible integrity. I am sure that you will all wish him to be a man who is not afraid of any minister in

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the House of Commons, but who expresses his opinions in a manly Englishman-like manner. I am also quite sure that you desire that your member should be a man who is accessible to his constituents; and whom you can reach at any moment of emergency. I am also satisfied that you would desire that he should be a man always ready to patronize your charitable and support your scientific institutions. Now gentlemen, I am also certain that you will agree with me that Sir Morton Peto answers to every one of those particulars. You all know how devotedly his energies are employed for the welfare of Finsbury. The energetic manner in which he carries out the pursuits of his business is really extraordinary. He is one of the most hard-working men I know of; indeed he is hardly second to the Premier of England. I am sure that you will all feel a pleasure in joining me in drinking his health, and in wishing that he may long live to represent the borough of Finsbury."

The toast having been drank with acclamations;

THE CHAIRMAN rose and said:—"My friend Mr. Knight has introduced my name to your notice in by far too flattering a manner, ("No, no"). I thank you, gentlemen, most heartily and sincerely for the kind way in which you have received the toast. I can only say with regard to my connection with the borough of Finsbury that I much regret that there should be so few opportunities of my meeting with my kind friends in its constituency. This I assure you in all frankness is to me a matter of sincere regret, because I should much like to meet you oftener, and have an opportunity of interchanging such friendly associations as this, and to give to each other mutual explanations in all subjects, which it is perfectly impossible otherwise to do, in so large a community. It is a pleasant duty on these occasions to meet our friends, to endeavour to promote a common object of interest and importance. Public men have much to try them, they have sometimes to do hard work and have very little opportunity for pleasure. Occasional meetings of friends, like this, are, therefore, to us seasons of great enjoyment. Here we have an opportunity of forgetting the cares of the world, and the rough side of things, and of looking rather at their smoother aspect; of saying to each other, 'well, here we are forgetting all our troubles, and joining in pleasurable association, for the promotion of a good object.' I am only sorry that I must run away from you; the army estimates, however, are now under discussion in the House of Commons, and my presence is wanted there. I am sure that you will, therefore, forgive my asking Mr. Knight to do me the favour to finish the business of the chair this evening, and in taking leave of you, I wish you a very happy evening; just to show you that I am not leaving you without a cause, I will read you a letter which I have this moment received from Mr. Cox, as follows; 'Dear Peto: we are in committee on the army estimates, pray come on, yours very truly, William Cox.' My friend Mr. Cox, and myself are on very good terms, we work together to the best of our ability for the public service."

The honourable Baronet then left the room amidst much applause, and his place was occupied for the rest of the evening by Mr. Valentine Knight.

Mr. JOHN JONES:—"I have to beg your permission, Mr. Chairman, to propose a toast. I am very happy to see you in the chair, Sir, because you will be able to appreciate the toast which I am about to submit to you, and that is the health of our Honorary Secretary. Mr. Hislop is a gentleman to whom the Institute owes very much; not merely for the work that he has performed in the discharge of his ordinary duties as Honorary Secretary, but for those which some divines call "works of supererogation." It is a long word, but it is not, I conceive, so long as the quantity of work, and the labours of kindness, which he has bestowed upon the Institute in that series of very valuable lectures on 'the Mechanical Forces' which he has been giving for some time past, for the benefit of the junior members of the Institute, and not alone for them, but even for those who are its seniors, and who will do very well to read them again and again, as without going to the Jura they may avail themselves of the valuable lessons, and practical philosophical principles those lectures contain; Mr. Hislop is a gentleman who brings to the service of the Institute a refined mind, enlarged by the acquisition of a wide range of knowledge, not limited merely to the mechanical arts, but extending to the various departments of natural philosophy, in one of which I have had the pleasure of occasionally meeting him on geological excursions, when I have been one of his gratified listeners, who have been surprised at the great amount of information he has brought to bear on that subject. Mr. Hislop possesses great power of systematizing or arranging, and of encouraging and urging work forward, so that on all points, although he was not the originator as Secretary, yet if there were wanted an originator, no man throughout the whole trade, I believe, could be more wisely pointed out for such a position, than our friend Mr. Hislop. Under his auspices happily, the Institute has reached what may be called "dry land." We have of course, like all juvenile institutions, had to contend with difficulties in the beginning of our career, under a certain amount of scoffing and jeering we commenced, but we proceeded forward, sometimes with little obstructions, but on the whole ever progressing, until we at last found in Mr. Hislop, *terra firma*, on which as from a new standing point, I doubt not with the energy he will bring to bear upon its affairs, the Institute will develope more abundant advantages than ever, be less hampered by petty obligations, and advance more than ever it has yet done for the benefit of the trade. I have very great pleasure, and I am sure that all the members of the Institute will have the same feeling in responding to the toast in proposing 'The health of Mr. Hislop, the Honorary Secretary to the Institute.'"

The CHAIRMAN:—"Before Mr. Hislop returns thanks, I should like to add a word in addition to what Mr. Jones has said; although I am sure that my doing so is a work of supererogation, for every member of the Institute present will endorse what I say, when I assert that I verily believe that if it had not been for the happy exertions, and the indomitable courage displayed by Mr. Hislop, this Institute would hardly have been in existence at the present moment."

The toast having been drank with applause.

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Mr. Hislop rose and said,—"Mr. Chairman and gentlemen, it would be affectation in me at the present moment, if I were to attempt to conceal from you the fact that I feel exceedingly pleased, and most grateful to you for the manner in which you have received the mention of my name this evening. It is not the first time on which I have had occasion to express a similar feeling. On all occasions all the members of the Institute have expressed the greatest kindness towards myself, and have always assisted me in helping forward the interests of the Institute. To the officers of the Institute I must also express my gratitude, inasmuch as they have put into my hands powers which might have been exceedingly dangerous in the hands of any man if he had not been restrained by a proper feeling from using them for harm. You have been pleased to place matters so thoroughly under my control that I have been able to do many things which I could not otherwise have done. I have taken this responsibility upon me, but whether in so doing I have been able to promote the welfare of the Institute, you are the best judges. If I have I am much gratified. I will not detain you at the present moment with any theoretical or philosophical disquisitions. After the many speeches you have already had, I think that I should not be justified in entering upon topics upon which I have often before addressed you. I can only again thank you for the very flattering manner in which my name has been mentioned and received by you; I can merely say in conclusion, that my experience during the past year, the duties which I had to perform in connection with the horological department of the recent International Exhibition, has proved to me more than ever, that the English horologists need to stand banded together and to labour for the advancement of their science, if they wish to maintain their position of pre-eminence in the world, We must work together or we shall never get on. All other scientific professions are doing so. Our respected member for Finsbury who has just left the chair, belongs to a profession which would never have got on at all, if they had not stood together; they have found the great benefit of an Institute of Civil Engineers. Neither can the English watchmakers succeed, unless they work well together as a body. For what is the art of watchmaking? It is as much a matter of constructive skill as is the erection of a bridge, or the formation of railway works. In fact, to produce a watch in any thing like a perfect state of manufacture, requires as much thought, and as much distressing action of the brain, as do the construction of those larger works, to which I have just referred. We must combine for the promotion of our science, or we shall never get on as manufacturers. Mr. Jones remarked upon the usefulness of the Institute in preventing men from wasting their time upon what they imagined to be mechanical inventions, but which had been previously discovered by others. Only last Saturday I had an illustration of the truth of Mr. Jones's remark. A gentleman called on me, and showed me a contrivance which he thought was entirely new; but which I found had been executed half a dozen times before, and yet this person had been ten or twelve years in bringing his work to perfection. That is just the position of a very large number of the members of the profession; they try to do that which has been done before, and simply for want of a little trouble in enquiring as to previous efforts, they waste their energies and shorten their lives, which might have been employed most valuably in other directions. I thank you, Mr. Chairman and gentlemen, for the kind feeling you have now expressed, and for the kindness you have manifested towards me in carrying out the affairs of the Institute."

Mr. E. D. Johnson:—"Mr. Chairman and gentlemen, I presume that there must have been some design on the part of the dinner committee that some one should do the sensational and create surprise. Only a minute ago I received the first intimation that I should have to take any part in the proceedings of the evening, and, consequently, I scarcely know how to begin to do proper honour to a gentleman, whose health I am requested to propose, namely, Mr. Strachan, the editor of the Horological Journal. I have certainly had an opportunity of witnessing the exertions of that gentleman, and I can bear testimony to his great ability, industry, and zeal in the performance of the duties of his office. I believe that we could scarcely have had a better man for the purpose; for he has been educated in a manner which if it has not made him a practical horologist, has made him thoroughly capable of undertanding the art of horology, and of fully estimating its value. Mr. Strachan brings to his work a clear understanding; he has an excellent method of management and is, in every respect, an acquisition to the Institute. It often happens that great difficulty is experienced in persuading gentlemen to accept offices for which they are more competent than many who make spontaneous offers to undertake them, but such was not the case with Mr. Strachan, who brings to the execution of his duties every necessary requisite for the editorship. I believe that in his hands the Journal is likely to prosper to the extent to which every true horologist would desire to see it attain. I am sure it will never, in his hands, be allowed to become the vehicle for the display of bad feeling, as similar publications are two often permitted to be. I believe that the Institute was under great obligations to its last editor, Mr. Gordon; but as mortals, we are not constituted to last for ever, and there must come a time when we shall in the course of nature be compelled to give up work, and others will be called upon to succeed us in our labours. In this way Mr. Strachan has been called upon to succeed Mr. Gordon, and to carry forward the work, which he had so long and so successfully performed. I have not had the pleasure of seeing him here this evening, but I hope that you will accord him his due need of praise, notwithstanding he is absent, I can pledge you my word that he is thoroughly worthy of every expression of approbation you can give to him."

The toast was drank with applause.

Mr Hislop:—"Mr. Chairman and gentlemen. In the absence of Mr. Strachan, I beg to return thanks on his behalf for the toast which you have just drank. As the Honorary Secretary of the Institute, and as one who has taken some interest in the Horological Journal, I can say that I have always found Mr. Strachan a very able coadjutor. It is

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utterly impossible for one person to fulfil every office. It is not within the power of an individual to go through all the labour requisite in managing the offices of the Institute, and bringing out a Journal monthly, and therefore it is necessary that we should have a journal committee and an editor. I again repeat, that in the absence of Mr. Strachan, and on his behalf I beg to thank you most heartily for the kind manner in which you have received the mention of his name."

The Honorary Secretary then read the list of donations which had been contributed during the evening.

The Chairman then said: "The next toast which I have the honour to introduce to your notice is 'Prosperity to the Watchmakers of England and foreign countries.' We will take the English first, if you please. I think that I may say without fear of contradiction, that in the article of the chronometer we stand completely unrivalled, I believe, in the world. Those who are disposed to pay a good price for watches cannot get better than they can in England. It is true that the Swiss make cheap watches; they beat us very much in price no doubt, but if a man wants a good sound genuine article, and is prepared to pay a price for it, I recommend him to take an English watch. At the same time whilst doing what is only common justice to the English manufacturers, I am quite willing to couple those of foreign countries with the toast. They certainly are a people of great energy, and they have shown us some very good lessons. I think that their schools of design, their horological institutes, and their division of labour, are examples of superiority which Englishmen should not lose sight of. My friend on my left (Mr. John Bennett) has specially entered into that subject. He is exceedingly well versed in it, and I will therefore take the liberty to call on him to respond to the toast."

The toast was drank with applause.

(To be Continued.)

HOROLOGY AT THE INTERNATIONAL EXHIBITION, LONDON, 1862.

By M. BOQUILLON.

Translated from Annales du Conservatoire Impérial by J. S. Harding.

(*Continued from page* 93.)

We have to express the same regret with regard to a new calendar of M. A. Brocot, the mechanism of which rests on a condition quite new to us. It consists in the daily shifting of each tooth of a ratchet wheel of thirty-one teeth, and operates, for the months of thirty-one days, by the movement of retraction of a lever armed with a catch, which the striking wheel-work pushes forwards till midnight; while for the months of thirty, twenty-nine, and twenty-eight days, this same ratchet wheel, when the teeth exceeding the number of days of the month present themselves, is pushed to the amount of one, two, or three teeth, by coming into contact, by a pin fixed upon it, with the extremity of one of the arms of a square, moveable on the same lever during the forward movement of the latter. The extremity of the other arm of the square, for the months of thirty-one days, takes its resting point on the circumference of a disk, making its revolution in four years by a monthly shift. In this case, the square and the pin do not come into contact; for the other months the resting point is at the bottom of a notch, the object of which is to determine this contact by lowering the horizontal arm of the square, and the depth of which is in proportion to the number of teeth by which the ratchet should be forced back to put the catch in connection with the thirty-first tooth, which it shifts beyond the movement of retraction of the lever.

This arrangement, simple as it is ingenious, presents a surety of effects quite remarkable, and which is rarely found in the *calendars* called *perpetual*.

The same motives oblige us to pass over in silence all the ingenuity of the new arrangements relative to lunations and to the equation of time. We shall limit ourselves to saying, with respect to the former, that it is scarcely ever necessary to adjust them, on account of the degree of approximation to which M. A. Brocot has arrived, thanks to his new method of calculation of the wheels, of which we shall presently say a few words.

But let us continue our review, dwelling solely on the ground of material facts.

It is known that the gaining or losing of a clock depends on the shortness or length of the pendulum regulating it, and that it is corrected by shortening or lengthening this pendulum, the length being very variable in commercial pieces; since the artist charged with the execution is almost always too jealous of the dignity of the art, to lower himself to render account of the professional necessities which clash with his conceptions, necessities which consist essentially in the employment of a heavy pendulum of a certain length. It results therefrom that, when an instrument varies under the influence of one of the thousand causes of disturbance which assail it, the possessor of this instrument, or the clock-maker who winds it up, is obliged to alter it without definite rule, especially if he does not know the length of the pendulum.

To remedy this, M. A. Brocot has arranged

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the suspension, contrived by his father, in such a manner, that by the ear or by touch, it is known to what extent the screw which serves to lengthen or shorten the pendulum has to be moved. For this object the dial shows the number of divisions which must be heard, or felt by the hand, to accelerate or retard the pendulum for a minute in twenty-four hours; and it is so arranged that this number corresponds to the number of centimetres contained in the length of the pendulum. We obtain therefore at once a very close regulator, by proportioning the number of divisions, heard or felt, to the amount of variation in twenty-four hours.

M. A. Brocot has not stopped at this amount of progress. He wished also to give to the manufacturer a method, as rapid as it is certain, of regulating very nearly the practical length of a pendulum, taken as it were at hazard. Calculation has demonstrated to him that for a gain or a loss of one minute per hour, the regulating pendulum is very closely approximated by lengthening or shortening the trial pendulum by a thirtieth of its actual length. It is sufficient therefore to observe, at the end of an hour, how much any pendulum whatever, adapted to an escapement, loses or gains, to know to what extent it is necessary to lengthen or shorten it, to regulate it approximately, which is easily continued to exactitude by means of the described conditions of the regulator. To render these conditions still more practical, M. A. Brocot has constructed a table giving for every deviation of ten seconds per hour, the exact amount by which the pendulum tried, considered as unity, should be lengthened or shortened. In fine, as a practical means, dispensing with all calculation, he has constructed a scale, the description of which would be too long for our limits, and from which, after the observation of the rate of the pendulum, it is sufficient to adjust the latter in the conditions wished, to have plainly indicated the amount, very nearly, by which it is necessary to lengthen or shorten it.

In 1857, M. Rosé presented to the Horological Society a very remarkable method, in a mathematical point of view, for calculating the best proportions to give to the different parts of the barrel, in instruments with springs. This method, it is understood, was far from being within the capacity of all practitioners, to whom M. Brocot has rendered a veritable service by arriving at the same results by means of a numerical calculation solely. One of the conclusions of this method is, that the spring presents the greatest possible number of turns which can be utilised, when it occupies in the barrel the half of the annular surface comprised between the arbor and the interior side of the barrel, or, which amounts to the same thing, when it is half the length which the whole cavity of the barrel would occupy. But in no possible case is the diameter of the arbor arbitrary; it should have, with that of the barrel, a proportion which use has proved to be the best. To solve practically the problem in all cases which may present themselves, M. A. Brocot has invented a kind of compass, which gives simultaneously the diameter of the arbor and that of the cavity, when its long legs introduced into the barrel have been separated in such a manner as to measure its interior diameter.

Again, independently of this instrument he has established the practical conditions which allow of a diametrical figure, by means of which the annular space contained between the inner edge of the barrel and the arbor is divided into two rings of equal surface. When a piece of clockwork has for its object merely the measure of time, divided into fractions commensurate with each other, such as hours, minutes, seconds, &c., the calculation of the wheelwork which gives this measure will present no real difficulty; but if, as in instruments which in the present day are sanctioned by fashion it is wished to combine with this regular measure of mean time the representation of certain astronomical phenomena, such as the revolution of the moon round the earth, its phases, &c., the calculation by the ordinary method is found to be beyond the capacity of the great majority of practical watchmakers, because the duration of the lunar revolution is not commensurate with that of the moveable pieces which compose the wheelwork of an instrument specially destined to divide the mean day into hours, minutes, and seconds.

Let us add, that those authors of treatises on horology who have written upon this subject, have not treated it with the necessary clearness, and, moreover, the figures which they have chosen either for their demonstration, or in the instruments which they have executed, have only a degree of approximation often very far from the truth, at the same time, that they require too many wheels, and also too long and too delicate workmanship. Science has quite at its disposal the method of continuous fractions; but this method is only within the capacity of the smaller number, and the results which it gives are so limited, that it is very rare that any one of them offers the solution of the problem sought.

(To be Continued.)

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ELECTRICITY OF THE ATMOSPHERE,

(*Concluded from page* 85).

Atmospheric electricity produces chemical, mechanical, and other physical effects, to which those we witness, on a comparatively minute scale, from our electrical implements, may be said to be analogous. Lightning melts and vitrifies masses of rock, sand, or soil, that it may strike, for a few feet sometimes below the surface; forming what have been termed *fulgurites*. It has never been known to melt a metallic substance possessing adequate conducting surface. When, however, the surface is not sufficient to form a ready conductor for a large electric charge, the material is rendered incandescent and may be melted. Thus many cases are recorded of lightning having completely melted watches, small chains and thin wires, parts of swords and daggers, and also thin layers or washes of metals. Larger masses, heavy chains, and stout wires, have been softened, bent, or distorted, but not melted. The mechanical effects of lightning are shown by such occurrences as large trees torn up and thrown to the ground, masses of rock hurled great distances, and houses crushed, walls and furniture forming a common ruin. Other physical effects are the burning of combustible bodies, the splintering, scarifying, and stripping off the bark of trees; depriving animals of life, or rendering them blind, or deaf, or paralyzing them; neutralizing magnets or reversing their poles; and it is highly probable that nitric acid is formed in the atmosphere during thunderstorms, since it can be formed by passing electric sparks through a mixture of air and vapor.

It is a well-known electric fact that the first and last in a chain of people feel the shock from electricity the most powerfully. Similarly where lightning enters and leaves a series of conductors occur the most damage or the most effective impression. It has been recorded of a thunderstorm which happened at Kronan, in Switzerland, that a lightning flash killed the first and fifth of five children sitting in a row, while leaving the middle three unhurt beyond a severe shock.

Some few words may be expected as to the precautions which should be taken against accidents from lightning. The highest objects of the landscape, those that are nearest the thunder cloud, will receive the lightning stroke,—such as mountains, trees, buildings, and,—if in a treeless plain,—men or animals. Hence the more elevated the body the more likely is it to be struck. Of two or more objects equally tall, and near, the lightning is invariably found to select the best conductor, and even to make a circuitous path to get to it. Hence the application and evident advantage of metallic rods, called lightning conductors, attached to buildings. The quality of trees as lightning conductors, it would appear, depends upon their height and moisture: those which are taller and relatively more humid, being struck in preference to their fellows; therefore it is unwise to seek shelter under tall and wet trees during a thunderstorm. In the absence of any other shelter it would be better to lie down on the ground. Experience seems to warrant the assumption that any building or ship, fitted with a proper lightning conductor, is quite safe from danger during a thunderstorm. Should a house, or vessel be undefended by a conductor, it may be advisable to adopt a few precautions against danger. In a house the fire-place should be avoided because the lightning may enter by the chimney, its sooty lining being a good conductor. Lightning evinces as it were a preference for metallic substances, and will fly from point to point, even out of the direct line of its passage, to enter such bodies. It is, therefore, well to avoid, as much as possible, gildings, silvered mirrors, and articles of metal. The best place is the middle of the room, unless a metallic lamp, or chandelier, should be hanging from the ceiling. The neighbourhood of bad conductors, such as glass windows, and on a thick bed of mattrasses, are safe places. A "Lightning Conductor" should be pointed at the top, and extend some feet above the highest part of the edifice. It should be made of copper, which is a better conducting medium than iron, and more durable, being less corrosive. It must be unbroken throughout its length, and extend from the top to the bottom of the building, and even some distance into the ground, so as to conduct the electricity into a well or moist soil. If it is connected with the lead and iron work in the structure of the house, it will be all the better as affording a larger surface and a readier means of exit for the fluid.

Our knowledge of the part which electricity plays in other atmospheric phenomena are not so well authenticated, nor so apparent, as in the thunderstorm. The displays

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of violet, crimson, and variegated tinted light emanating from the horizon upward, which take place in high latitudes, and are called *auroræ boreales*, or *australes*, according as they witnessed in the northern or southern hemisphere, are attributed to magnetic as well as to electric causes. A faint resemblance to this phenomenon is observable in a darkened room when electricity from a machine is passed through a glass tube, from which the air has been exhausted by an air-pump. This certainly does not go far to explain the natural aurora. Many hypotheses have been resorted to for a satisfactory account of its origin; it remains, however, one of the deepest secrets of nature. Its evident connection with atmospheric commotions has been well established, and hence the investigation of every circumstance coincident with auroral displays has become of the utmost interest. It seems to be confirmed beyond doubt, that telegraphic wires are affected, so that messages are actually suspended during the prevalence of the aurora, and it is affirmed that gales follow it after short intervals. If this could be well authenticated it would be a fact of especial value to seamen. The Rev. George Fisher, who was the astronomer to Parry's Arctic expedition, during the years 1821-2-3, is of opinion "that the principal displays of aurora occur in the vicinity of the edge or margin of the Frozen Sea, and occasionally at those places in more temperate climates where humid vapors are accumulated, and by the operation of certain causes such as tides, winds, &c., are brought suddenly within the influence of a cold, dry atmosphere, and thereby subject to rapid congelation; that the aurora is an electrical phenomenon, and arises from positive electricity developed by the congelation of these vapors, and the consequent induced negative electricity of the upper and surrounding portions of dry atmosphere. It is the accompanying indication of the restoration of the electric equilibrium; which equilibrium is restored by the intervention and conducting power of minute frozen particles, which particles are rendered luminous by the transmission of the electricity, thereby causing the various appearances of the auroral light, and forming an irregular zone or girdle of aurora round the pole."*

The columns of water which are frequently observed by mariners, especially in the tropical seas, rising out of the ocean, and moving onward, rotating as they travel, have been referred to electrical causes. They are commonly called *waterspouts*, and consist of a column of water attached to a cloud forming a general resemblance to the neck of a funnel, the cloud itself being the funnel. Maybe the water is whirled about in the cloud by the rotatory motion it has acquired, and is thrown off again; or it may not ascend beyond a definite height. They are supposed to be produced by the attractive force of highly electrified clouds upon the surface of the sea. Such a cloud would act inductively upon the sea, until the opposed water-surface had become oppositely electrified. The mutual attraction then exerted, would tend to draw cloud and water together. Hence the water-spout; which is carried onward by the wind, and by reason of its inertia maybe the lower part is caused to resolve. Waterspouts are of short duration; generally, after contact with the cloud is formed, the whole discharges like an avalanche. Their electric nature appears evident from their frequently being accompanied by flashes of lightning. A very curious analogy presents itself in the following quotation:—"At Messrs. Brooke's Cannon Foundry, in Birmingham, the steam boiler is high above the level of the ground, and the feed pipe is supplied from the canal. Strange to say the pipe does not go to the water by some inches. When it is desired to feed the boilers a valve-cock is turned, the steam rushes to the water in the canal, and without any pumping the water ascends the pipe and enters the boiler much like the action of a syphon. The members of the Scientific Association the other day could not, it is reported, account for this phenomenon; but in this instance there is no doubt but the agent is electricity. There is the positive and negative fully developed. Where nature performs the labour she does it well, for the water flows in quantity through the two-inch feed pipe of Messrs. Brooke as fast as it could be pumped up through a four-inch one. We are therefore in comparative ignorance at present as to what electricity can do."†

And thus, though the world has added two hundred years to its age, since Bacon left it, and in this time the experience gained by man has enabled him to make fire and water his obedient slaves, galvanism and chemistry his cunning workmen, electricity his swiftest messenger, and the sun an unerring limner, yet still does the aphorism of that profound philosopher apply:—"Man hath power in natural things only to bring them together, and to set them asunder, nature conducteth her processes in secret."

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* *Vide* Eleventh Report of the British Meteorological Society.

† Mitchell's Steam Shipping Journal.—Nov. 1862.

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CHINESE HOROLOGY.

Clocks are not often met with in China; they are chiefly confined to the public offices, where it is not uncommon to find half a dozen, all in a row. The number manufactured cannot be large; for in the richest cities in China clock makers are not numerous. At Nankin there are forty shops; at Suchan, thirty; at Hangchan, seventeen; and at Ningpo, seven; the average number of men employed in each being less than four, who are mostly employed in *repairing* watches and clocks. The cheapest clocks they make cost thirty shillings—some are worth twenty pounds—the most common price being about five pounds each. A manufacturer estimates the number of clocks made at the above places at 1,000 per annum, and probably 500 more would exceed the annual manufacture of the empire. A few watches are made, with the exception of chains and springs, which are imported. The oil used by Chinese workmen to abate friction appears to be particularly adapted for the purpose, though expensive; it is obtained from the flowers of the olive, *olea fragrans*.

Clocks were introduced into China from Europe, and have entirely displaced clepsydras, which for many ages previously had been used by the Chinese for timekeepers. In this instance, therefore, the Chinese do not appear the stationary people they are so often represented to be. The Chinese automata, so much admired, are, in their internal structure, imitations of foreign articles.

In *dialing* the Chinese have never accomplished anything, being deficient in the requisite knowledge of mathematics and astronomy. There is a sun dial in the imperial observatory at Pekin, above four feet in diameter; smaller ones are sometimes met with in public offices. These are all made under the direction of the Catholic clergy or their pupils. The Chinese divide the day into twelve parts, which are not numbered, but designated by characters; each of the twelve hours is divided into eight *kĭh*, corresponding to quarter hours.

A native writer on antiquities says:—"The western priest, Limátau (M. Ricci), made a clock which rendered and struck time a whole year without error." The clock brought out by Ricci, if not the first seen in China, is the earliest of which mention is made in Chinese history. They subsequently became an article of import, and this branch of trade was at one time of considerable value. Clocks and watches of very antique appearance are often met with, specimens of the original models, scarcely to be met with elsewhere; some of the latter, by their clumsy figure, remind one of their ancient name, "Nuremburg eggs;" but their workmanship must have been excellent, or they would not be found in operation at this late day.

The Chinese must have commenced clock making at an early period, as none now engaged in the trade can tell when or where it originated; nor can it be readily ascertained whether their imitative faculties alone enabled them to engage in such an undertaking, or whether they are indebted to Europeans for what skill they now possess.

It is certain that the Jesuits had for a long time, and until quite recently, in their corps at Pekin, some who were machinists and watchmakers. One of these "horologistes" complains in *Les Lettres Edificiantes et Curieuses*, "that his time was so occupied with the watches of the grandees, that he had never been able to study the language." Doubtless the fashion which Chinese gentlemen have of carrying a couple of watches, which they are anxious should always harmonize, gave the worthy fathers constant employment.

[Abridged from an article by Dr. D. J. Macgowan, in the *Manual of Science and Art* for May and June, 1854, a periodical which appears to have been an early failure.]

GOLD BALANCE SPRINGS FOR CHRONOMETERS.

We lately noticed that gold balance springs were exhibited at the International Exhibition of last year, by Messrs. Ganeval & Callard, and stated that they claimed for them "all the qualities of the best steel springs, besides the advantage of not getting rusty or magnetic." Since then we have received a communication from Messrs. Jurgensen & Sons, of Copenhagen, relative to the chronometers which they manufacture with similar balance springs. They write,—"Balance springs of gold not only embrace the inestimable advantage, not to be damaged by *rust*, but also not influenced by *magnetism*. This property appears to be the more important, with reference to box chronometers, as the applicatien of iron for shipbuilding is still getting more extensive. Balance springs of gold must therefore, as well with reference to rust as magnetism, be preferable to balance springs of steel, which are applied in general. That the rates of chronometers with golden balance springs is as good as those provided with springs of steel is, according to our opinion, best proved by the

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reports of the rates of several chronometers which have been observed on land, in the Observatory of the Danish Navy, at Copenhagen, as also on board the Danish ships of war."

With reference to their own productions they quote the report of "the Astronomer Royal and Director of the Observatory at Altona," (vide, *Schumacher's Astronomische Nachrichten*, No. 1264), which says:—"A considerable number of chronometers has been executed in Mr. Jurgensen's establishment, which have all proved the superiority of the construction. We shall especially draw attention to the cylindrical balance springs, in these chronometers, which are made of *gold*, and with respect to the principles—as to alloys, elasticity, and dimensions—based upon the experience of a great many years. The great advantage of the application of golden balance springs consists in this, that they are not exposed to rust, while the common spirals or balance springs are attacked early or late by rust, on account of the evaporation from the sea, which cannot be avoided. The rates, of many chronometers, which have been excellent for a great many years, are suddenly deranged because the balance springs get rusty."

In thus placing before our readers the substance of Messrs. Jurgensen's communication, we would remark that a great deal yet remains to be shewn to the advantage of the golden spirals before they can be considered as good and serviceable as those of steel, notwithstanding the attendant defects. Does gold, or any alloy of it, maintain its elasticity unimpaired, for a number of years? In the course of time, may not its component atoms undergo some peculiar change whereby the springs may be rendered brittle, and liable readily to snap? In other words is its tenacity as unalterable as that of steel? We believe that many who have experimented a great deal in this direction, have no faith in the superiority of gold over steel in the manufacture of balance springs.

To provide against the action of vapor upon the balance spring, sundry methods have been suggested. Perhaps the most efficacious yet patented is Mr. E. D. Johnson's Hermetic Box for the Chronometer, which is devised to exclude all dust and vapor from the works. And as regards the effects of the ship's magnetism upon the balance, Mr. Johnson has also, years ago, invented a mechanism to guard against it, known as the Magnetic Disperser for Chronometers. Neither of these inventions has received that attention, either from chronometer makers, maritime officers, the Admiralty, or scientific authorities, which the importance of their objects would seem to justify, and we believe that the patentee, thoroughly disheartened, has virtually abandoned both these patents. Manufacturers are therefore free to carry their experiments in various directions with the view of remedying the two defects of rust and magnetism in the balance spring; and in these pages we shall be delighted to record their results.

METEOROLOGICAL OBSERVATIONS

Taken at 9 A.M., MARCH, 1863.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	°	°	°	°				
1	29·990	46	42	53	39	SSW	4	bc	p, ch,b
2	29 947	50	48·5	50	44	SSW	4	o	p, o, b
3	29 886	47	44	56 5	43·5	SSE	3	b	b
4	29·717	44·5	43	62	41	S	1	f	bc
5	29 702	44	42·5	60	39	Calm.	0	f	b
6	29·573	50	47	60	42	SSE	4	b	cb, r, o
7	29 618	43·5	40·2	55	41	WNW	3	c	r, b
8	29·601	40	37	49	35	NW	4	b	prh, b
9	29·637	35	33	47	32	NW	2	bm	c, f
10	29 401	33·5	32	45	32·5	Calm.	0	f	f, rm
11	29·536	36	35	41	32·5	NW	3	b	o, cb,
12	29·452	39	37 5	43·5	32	SE	4	c	o, r, m
13	29·288	37	36	43	35	NW	2	m	c, mb
14	29·518	39	37	50	33·5	SSW	2	bm	mc, rr
15	29 230	41·5	40·5	48·5	36 5	NW	3	c	r, bc
16	29 848	41·5	39	43 5	36	NNW	4	cb	cb, b
17	30·220	38	36	47	34	N	5	b	cb, b
18	30 034	35	33	46·5	31	Calm.	0	f	ff, cb
19	30·096	42	39 5	45·5	34	NNW	3	c	cb, r
20	29·948	45	44	50	40	SW	4	o	cb, oq
21	30 056	47	43	56	44	NW	6	b	o, b
22	30·391	41	39	51	34	NNW	1	bm	c, cm
23	30·445	44	43	56	40	NW	3	o	o, c
24	30·486	48	44	61	42	N	1	c	cb, m
25	30·548	49	47	61·5	45	Calm.	0	f	ff, mb
26	30 370	46 5	43.5	59	41	WNW	3	b	c, b
27	30·435	44	40·5	58	38	WNW	3	b	b
28	29 987	52	47	55	43	NW	7	cb	cb
29	29·818	51·5	47	58	48	NW	7	o	cb
30	30·021	50	47	57	47	WNW	4	c	op,r,cb
31	30·256	43·5	40	55	41	SSE	4	bc	bc
	29 905	43·4	40·9	52·4	38·6		3		Mean.

REMARKS.

The atmospheric pressure was 30·550 at 8 a. m. 25th, and 29·195 at 11 p.m. 12th; so that the extreme range was 1·355 inches.

From the 10th to the 13th, the wind veered from WSW to N, through E and S, to WNW.

Rain fell on 11 days, during only 35 hours altogether, and only 0·72 of an inch was collected by the gage. Fog prevailed for

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17 hours on the 18th, and during the whole month the hours of fog were about 27.

According to the 9 a.m. observations the wind has been from the N on 10 days; E, 2; S, 6; and W, 9; while 4 days are noted as Calm.

The month has not been accompanied with the usual equinoctual gales, in our locality. The mean pressure has been about the average for March; while the temperature has exceeded the average by about 3°. Rain has been very deficient.

Indications for May.

At London the length of the middle day of May is 15½ hours; average barometer (reduced) 29·95, and probable range 1 inch; on an average the heat of the *day* reaches 64°·5, and the *night*, 46°; the prevalent winds are from S to W; average rainfall 2 inches, on 16 days. Towards the end of May the temperature sometimes exceeds 80° in the shade.

Edinburgh Horological Society.

On Saturday, the 11th April, a dinner in celebration of the first year of the formation of this society took place in Main's Hotel, Newhaven. Upwards of thirty gentlemen were present, Mr. I. L. Hanald, President of the Society, ably filled the chair; and Mr. Dd. Meek, Vice-President, acted as croupier. The cloth having been removed, the usual loyal and patriotic toasts were given, and enthusiastically responded to. The chairman then gave the toast of the evening,—"Success to the Edinburgh Horological Society,"—in the course of his speech the chairman referred to the great success which had attended the efforts of the promoters of the society, far exceeding their most sanguine expectations, he referred also to the steady increase of the library, which began with the handsome donation of three volumes of the *Horological Journal*, from the Council of the British Horological Institute, through their honorary secretary, W. Hislop, Esq. and intimated that the secretary had received a communication from B. Woodcroft, Esq., of the Great Seal Patent Office, stating that the Commissioners of Patents had very generously resolved to present the society with the volumes of *Specifications of Patents relating to Horology*, also the volume of *Abridgements* relating to the same. The chairman concluded by reminding the members that they had achieved what had hitherto been regarded as an impossibility, viz., a society of watch and clock makers in Edinburgh.

The toast was drank with the greatest applause.

During the evening, the chairman in a neat and very complimentary speech, presented to the secretary—on behalf of the society—a very handsome writing desk, a plate on the testimonial bearing the following inscription:—"Presented to Mr. John Mc Kay, by the Edinburgh Horological Society, in token of his valuable services as their secretary, April 11th, 1863." The evening was most harmoniously spent, several excellent speeches, humorous songs, and well-delivered recitations, combined with numerous toasts, sustaining the conviviality up to a late hour.

ABRIDGMENTS OF SPECIFICATIONS OF PATENTS

RELATING TO WATCHES, CLOCKS, AND OTHER TIMEKEEPERS.

(*Continued from page* 23.)

1852, October 15.—No. 408.

MATTHIAS, WILLIAM JAMES, and BAILEY, THOMAS.—1. Distributing the power over the machinery of clocks so as to be applied direct to the twelve hour action, instead of the one hour action.

2. Arranging the works so that the going or time-keeping parts shall receive motion from the striking action, and that by winding up the striking action the time-keeping action shall be wound up, by which arrangement also the running down of the striking action keeps the going action in motion.

3. Regulating and governing the action of clocks by means of a screw remontoir movement, which may either be combined in the same case with the other parts of the clock, or in a separate case at any requisite distance. This is particularly applicable to turret clocks.

4. The application of the power direct to the twelve hour action to watches also.

By the above arrangements the fusee is dispensed with, and also the works of the timepiece are compressed into such a narrow space as to afford room for illuminating.

[Printing, 8½*d.*]

(*To be Continued.*)

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The Journal may also be had at the following Watch Tool Warehouses:—Delolme's, Rathbone-place; Rhnhuis, 53, Frith-street, Soho-square; Grimshaw, 159, Goswell-street; E. Hunt, Ironmonger-street; Lowther, Red Lion-street; Muller, King-street, Soho; E. J. Thompson, 5 & 6, Percival-street; Williamson, Frederick-place; Stevens, Goswell-road; Haswell, Spencer-street; C. B. Johnson, Market-place, Prescot, Lancashire; Margetts. "P.O." Goswell-street; and of all Booksellers in Town, or Country.

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THE BRITISH HOROLOGICAL INSTITUTE.

THE ANNUAL DINNER.

(*Concluded from page* 100.)

Mr. JOHN BENNETT:—"Mr. President and gentlemen, I cannot refuse when so called upon, to do myself the honour of saying a few words in answer to the toast which has just been given by the Chairman, and which has been responded to by you. The toast includes, not only English watchmakers, who are celebrated for first-class work, but it refers to those also who are regarded as their foreign rivals, because at the first blush of the thing it seems as if their prosperity was to our detriment, and that what they were gaining we were losing. But I am not sure of that. I have always thought that the world was a very large one, and especially so for the wearers and buyers of watches. My theory of the matter is, that as the circle of civilization extends every year, as every year there is a march of events, so every year the circle is widened of those who want that most essential article of life—that great agent of civilization—a time-keeper, without which it is impossible for us to go through life with full usefulness and credit. Whilst this continues to be the case there is room enough for the prosperity of all who can be engaged in the manufacture of watches, either in Clerkenwell or upon the Swiss mountains. It should I think be a source of comfort to us to remember, that this constant progress of mankind has in former years been the very foundation of our success. Your Chairman stated what is incontrovertible when he declared that the marine chronometer made by Englishmen was unrivalled. It was perfection when it came from the hands of Tom Earnshaw and Arnold, so much so that it was the example upon which every chronometer made in subsequent years has been manufactured. Professor Airy and others tell me, 'If you require too much in the manufacture of your chronometer, you run the risk of creating greater errors than those you are trying to cure.' ('No, no.') I am answered by 'no, no,' that is what I am told, however. A man may get a little out of it, but still that which came from the hands of Earnshaw and Arnold was the perfect chronometer in principle; it is the model upon which good watches are made all over the world. As far as the theory is concerned that is the chronometer model which has made Englishmen celebrated for the manufacture of that instrument all over the globe. What, I should like to know, could be better instruments than those made during the last generation by Mc Cabe, which fetched seventy guineas each; I had in my hand this day an old pocket watch made by Mc Cabe. A venerable general who had been in India many years had had it with him through all his campaigns there. He said to me, 'I want nothing more perfect than that. It is as perfect now as it was the first day when it came into my hands.' It is undoubtedly true that for the highest class work the world is ready to believe what your Chairman has said. If men want a first-rate watch, a highly respectable instrument, they cannot do better than pay a highly respectable price to a highly respectable man in the heart of London. But it happens that all the world is not so wise as this! they like to buy things at one-fourth, and sometimes one-tenth, the cost of these respectable articles. They like those watches which are produced on the largest scale, not only by thousands but by millions, made with greater compactness and elegance than ours are, and with more beauty of shape and decoration. Such are the watches which come from the hands of our great rivals abroad. I say, then, that it is quite possible for the watchmakers of this country to take a lesson from those in foreign lands, and whilst continuing to make first-class watches, I think they should also make others almost as cheap as those which are produced in such enormous numbers in Switzerland. I thought whilst Sir Morton Peto was speaking upon the value of the watch, that he exemplified its importance in his own person. We are told that once upon a time men lived upon earth for a thousand years; but what was a year then to what it is now? We are told that there were giants in those days; but what was their mere animal power without a watch? What was the use of their thousand years, and what their gigantic strength, without the great agents of civilization, amongst which the watch stands pre-eminent; I will be bound to say that Sir Morton Peto in his vast operations is able by means of the watch, by the regulation of time through the small instrument which he has in his hands, to do a thousand times as much,—to originate a thousand times as much—for the world's good than though he had lived for a thousand years and possessed a giant's strength. He has done things which the giants of old could never have dreamed of. See then, how important to the world is the watch. How important is the work in which we are engaged. I therefore, Sir, have much satisfaction in most heartily responding to the toast of 'Prosperity to the English and Foreign Watchmakers.'"

Mr. KLAFTENBERGER:—"Mr. President and Gentlemen, I rise to propose the health of the Visitors. I am sure that we are all proud to see the great number of gentlemen who have come here to-night to shew their interest in the prosperity of the British Horological Institute. No doubt they will be much gratified at what they have heard respecting its success. Under such circumstances I think we cannot do better than drink their good healths, wishing them long life and happiness. I beg to couple with the toast the name of Vice-Admiral Manners."

The CHAIRMAN:—"I will take the liberty, if you please, gentlemen, to propose an addition to

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the toast. Mr. Klaftenberger has referred to the fact that we have had the honour of the company of Vice-Admiral Manners amongst other gentlemen on this occasion. We know that he rendered good service to the art of horology by kindly accepting the office of one of the jurors in in that department of the International Exhibition. But we know also that the gallant Admiral is a Fellow of a learned body whose proceedings are intimately connected with the art of horology, I refer to the Royal Astronomical Society. As we are all admirers of science, and as there is no science which comes up to that of astronomy, I am sure that you will agree with me, that we only pay him and the scientific association with which he is connected, a just compliment when we drink his health as the representative of the Visitors, coupled with 'Prosperity to the Astronomical Society.'"

The toast was duly honoured.

VICE-ADMIRAL MANNERS:—"I beg to return you my sincere thanks for the honour you have paid me, in coupling my name with the health of 'The Visitors,' and to the company for the cordial manner in which they have received it. When I accepted your kind invitation to be present on this occasion, I certainly looked forward to the usual pleasures that one meets with upon such festive occasions amongst friends, but I did not expect that I should be called upon to sustain a philosophical character. Mr. Jones has alluded most eloquently to the power of the inventive genius engaged in your Institute, and likewise to its usefulness in bringing into exercise the highest faculties of the human mind in connection with the construction of instruments of such precision as the watch; Mr. Bennett has also explained to us most philosophically, facts more particularly relating to its mechanical construction, and if I may be allowed the term, to the statistics of the manufacture. These are things which I was not prepared to hear discussed here, and I have most unexpectedly derived great information from the proceedings of the evening. It was further most truly remarked by Mr. Bennett, that the ancients who lived for hundreds of years could not by any means so profitably have employed their time as we can, but there is an old maxim of the ancients, which some gentlemen have no doubt learned in their school-boy days, the application of which was certainly not always of a friendly character, signifying 'We arrived in good time,' from which I suspect that they had a knowledge of the value of keeping time. As our chairman has said, there are no men who so thoroughly appreciate the importance of precision in the manufacture of horological instruments as the members of the Astronomical Society. As a naval officer, I can likewise speak as I have done already of the immense importance of horological precision in navigating ships. No doubt we could struggle on without it, as we did in former days, but I should be very sorry to have to do it now. The Astronomical Society however, could not dispense with such precision; and therefore in the name of the Astronomical Society, I beg to return you thanks for the great service you have rendered us. I will not detain you longer except to express my gratitude to you for these benefits. Before I sit down I may state to you the fact that all Europe is looking to your skill and exertions. You produce the most perfect instruments of precision in the whole world. There is no question about that, and there is no flattery in my telling you so, the advancement of science must go hand in hand with the improvements effected in philosophical instruments. In all such matters precision is the great object in the present day. It is impossible for the world to arrive at that state of advancement which we expect to see it attain without your help."

The CHAIRMAN proposed "The Press," coupled with the name of Mr. Farmer.

The toast was duly honoured.

Mr. FARMER briefly responded to it.

The CHAIRMAN then proposed the next and last toast upon the list 'The Ladies;' in a highly complimentary manner; and it was drank with applause.

The CHAIRMAN:—"Gentlemen, I am sure that you will all be anxious to join me in doing honour to one of the best supporters of the Horological Institute. I do not think that we should be doing justice to our own feelings or to our esteemed friend, Mr. E. D. Johnson, if we did not drink his good health. I am sure you will all feel with me the great interest he has taken in the Institute from its first foundation."

The toast was drank with applause.

Mr. E. D. JOHNSON:—"I suppose that I must attribute this last expression of your kind disposition, of which I have had so many proofs, to my sympathy with the British Horological Institute, the proposition for the foundation of which emanated from myself. It has been said, although somewhat cynically, yet not without some degree of truth, that men are inclined to hate those most whom they have the most deeply injured, let us take the converse of that proposition and say, and I believe that there are none who can contradict the assertion, that we love those most whom we have had the greatest opportunity of benefitting. If any one of the founders of the Institute had been called forth to represent it, I could have understood that it should have been our President, because you Sir, were called forth from your leisure and retirement, to enter anew, as it were, upon public business, and to undertake fresh labours for the welfare of the Institute. At the first meeting for its origination, although others in their humble way may have placed the lever in your hands, it was to your influence that its first success was attributable. The name of Valentine Knight stamped the proposition with a character of genuineness and importance in the eyes of the world; and furnished a guarantee that the Institute would be calculated to do good because every body knew that if some good was not to be effected by it the name of Valentine Knight would not be connected with it. I have had much pleasurable emotion from observing the growing character and influence of this Institute. I entered into its pro-

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motion purely from a love of art; and I continue to promote it to the best of my ability, just because it is an object of my affections. I believe that the watch makers have only wanted some such institute as this, to enable them long ago to achieve far greater ends commercially than they have yet effected. Mr. Knight comes amongst us with all the freshness of youth, and takes his seat among us at all our trade asssociations, and in every thing connected with the interests of Clerkenwell. It is nothing but right that we should do such men honour. As President of the Institute, he is never absent on occasions of real business; he is always ready to attend to promote either business or conviviality. His kindness in this respect is all the greater, from the many calls which we know he has upon his hands. The oftener we see him, the better are we pleased. Although only about five or six years old, the Institute has been of essential service to the horological art. For the compliment you have paid me, Sir, in connecting my name with the origination of the Institute, I thank you. As long as my means and my breath will permit, my name will never be wanting as one of its warmest supporters."

Mr. E. D. Johnson again rose and said:—"Gentlemen, I should like to propose the health of Mr. Valentine Knight as President. He has often told us that in early life his fortune was made in Clerkenwell; but although he has now retired from it, he does not, as many do, turn his back upon it."

The toast was drank with the greatest warmth of feeling.

THE CHAIRMAN:—"Mr. Johnson and gentlemen, I thank you for this renewed mark of your kindly feelings towards me. I have always felt a deep interest in the welfare of Clerkenwell, and I hope that I always shall continue to do so. At an early age I set up in business in it in the engine turning and gold dial departments. I happened to have a very lucky rise. I chanced to make an article in the gold dial line, such as I believe I may say with truth, was equalled by no other person. When Americans came either to Coventry or London to give orders for watches, they almost always insisted upon having Knight's dials; that was a very great advantage to me. To a certain extent I was a child of fortune, I succeeded much beyond my expectations. During many years I worked sixteen and eighteen hours a day, and sometimes all night. Such an enormous business I was sure could not last, and I therefore thought it better to make hay while the sun was shining. I did so, and at a comparatively early age was enabled to retire from business. Competition, when I was in business, was very different from what it is now. I should be ashamed of myself if ever I forgot the parish of Clerkenwell, and particularly its watch trade, which I am sure that I shall never cease to take an interest in, I have great pleasure on all occasions to find myself associated with the members of that trade, and with the inhabitants of the parish generally. As long as I am able to give my mite to its institutions, I will do so with great pleasure, although I am not so juvenile as I once was. I thank you very much for the kindness which you have shown to me upon this and all occasions."

The proceedings then terminated.

HOROLOGY AT THE INTERNATIONAL EXHIBITION, LONDON, 1862.

By M. BOQUILLON.

Translated from Annales du Conservatoire Impérial by J. S. Harding.

(*Continued from page* 101.)

The general problem is as follows:—

Any motor whatever of wheelwork whose velocity is known, being chosen as a starting point, to find by the motion, which it will effect, the number of teeth which will give to the last of these movements a velocity approaching as nearly as possible to exactness.

M. A. Brocot has succeeded in establishing a practical method, within the capacity of the majority of persons, for effecting the object, with such a degree of exactness as may be wished for.

The following is the fundamental basis of this method:—the ratio of the velocities between the two extreme motors may always be expressed by an ordinary fraction. But, if the numbers representing the two velocities are incommensurable, as in the case we are now considering, the numbers which will be derived from this fraction are not exact, and will give to the last motor either a too great, or too little velocity. If they are sufficiently exact for the object in view, that is enough; if not, recourse must be had to other numbers approaching nearer to the truth; on the other hand, as is most frequently the case, we obtain prime numbers which cannot be divided, and which are too high for teeth on a wheel of convenient size:—another reason for the rejection of the proportion found.

The basis of M. A. Brocot's labours consists in the modifications that the ratios, or fractions, added term to term, undergo. If we add in this manner two fractions or two ratios giving one too small, and the other too great a result, the new fraction, without being the mean of the other two, will give a result greater than that of the

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first, and less than that of the second. If its division gives too great a prime number, it can be added term by term with the two fractions from which it is derived, and so on; thus obtaining at will, new fractions, approaching more and more to exactness, and among which can be found numbers successively divisible, and applying to wheels of convenient dimensions.

To render his method more practical, M. Brocot has published a table of ordinary fractions, no denominator exceeding 100, and opposite, the decimal fractions which correspond. The object of this column of decimal fractions is to facilitate investigations, being classified in order of greatness, and thus one arrives, at once, at the ordinary fraction which is the nearest in the table, to the fraction resulting from the problem given.

Such are the general conditions of the "Nouvelle méthode du calcul des rouages," of which M. A. Brocot has yet only published the table in question, and respecting which, we deeply regret our inability to enter into greater detail.

We will not leave M. Brocot without mentioning that he is the manufacturer of instruments for chimney pieces which go for a year, by means of an arrangement invented by M. Maurel,* and which consists in a series of barrels governing each other mutually and successively by the arbors and toothed edges in such a manner as to restore simultaneously, by equal portions, the force distributed by the barrel, the prime mover of the wheelwork—a condition analogous to that which would result from continually winding up a single barrel, at each moment of the year.

If the barrels governed each other reciprocally in the same conditions, that is, either by all the axes, or by all the toothed edges, the result would be an increase of force proportional to the number of barrels, without affecting the time of the going. But being governed alternately by the arbor of the first barrel on the toothed edge of the second, whose arbor governs the toothed edge of the third, &c., the force of the barrel remains the same as if it were alone, and the time of going becomes proportional to the number of barrels.

M. Redier is an artist, who in addition to the labours of an immense manufacture of ordinary articles, unites patient and incessant studies, which bring scientific theories within the domain of practice, of which his exhibition at London is a proof. We observe in the first place two regulators compensated with mercury; but in stead of the single tube which constitutes this kind of compensation wherever we have met with it, M. Redier has employed two, not only to satisfy the conditions of symmetry in a valuable instrument, but more particularly because thus divided, the mass of mercury is brought more rapidly into equilibrium with the temperature of the atmosphere. We remember that in 1839, M. Duchemin, the predecessor of M. Redier, moved no doubt by the same considerations, had also multiplied the number of tubes, which, communicating together, could take besides, on the stem of the pendulum, a position more or less inclined, which allowed the virtual length of this pendulum, to be regulated with an extreme precision. It is true that symmetry was wanting in this combination, but this sort of Pandean pipe balancing itself in space produced a very original effect. The horology of precision cannot but gain by these revivals of good practical conditions, too easily abandoned, and we are indebted to M. Redier for having exhumed this one, for the benefit of the rising generation. Two other regulators, in which M. Redier's principal aim was precision, comprise an escapement without crutch; an arrangement applied very long ago, the one with anchor, the other with pins, and which differ from the known escapements, in that the *levée* and *chute*† instead of taking place on rigid levers, act upon flexible levers whose elasticity deadens the blow; so that this same "chute" may be accidentally strong or weak without the rate of the pendulum being sensibly affected by it. It is the same with the levée which being flexible yields under the action of the escapement wheel, when this action is not in connection with the rate of the pendulum. It results therefrom that certain conditions of precision, of absolute necessity in ordinary constructions, have now only a secondary importance; that when a disturbing cause of the equality of the motor presents itself, the consequences produced are slower in action, and lastly, in

* M. Maurel is also the inventor of the ingenious calculating machines, which the Academy of Science judged worthy of the Mechanics' prize, established by Montyon.

† By the word *levée* is denoted, the arrangement which restores to the pendulum the velocity lost during a simple or double oscillation, as the case may be. The *chute* is the space traversed by the tooth or pin, of the escapement wheel, which gives the impulsion after the impulsion given, to reach the instrument of repose, which checks periodically the wheelwork, until the next impulsion.—(Anglice "drop.")

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defects of this nature arising from the tooth-work, the cause often disappears before the effect is produced.

To verify experimentally the results of this arrangement, M. Redier has constructed escapements whose levers become, at will, flexible or rigid. The following are the results of his experiments:—with flexible levers less motive force is required to obtain the same arcs of oscillation. When the motive power is suddenly augmented, the arcs still remain of the same extent for a long time, whilst they increase rapidly with fixed levers. Lastly, when the motive force is diminished suddenly the results are nearly the same for flexible, as for rigid levers.

These are evidently important results, which the observations of long periods will probably confirm.

An English exhibitor, whose name has disappeared from our notes, exhibits also an escapement fixed upon the pendulum, and with flexible levers, but with an arrangement quite different from that of M. Redier. The absence of this exhibitor, as well as the distance his instrument was placed from visitors, did not allow us to examine the details, and consequently we cannot give an opinion as to its value.

For many years the house of J. Wagner has constructed escapements whose levers are susceptible of separating from each other, and are only maintained at their nominal distance by the action of a traction spring. But the only object of this flexibility is to prevent the pins of the escapement wheel from breaking, when the negligence of the winder of the clock has suffered the motive weight to reach the ground, which necessarily stops the wheelwork but not the heavy pendulum, which continues to oscillate during a certain time. If in this case, one of the pins of the escapement wheel was to come in contact with one of the ends of the anchor, it would be certain to break, if the end had not the power of yielding by stretching the spring in question.

But to return to M. Redier. His chronometric compass is a kind of watch with independent seconds, in which the hand can be put in exact accordance with the seconds' hand of another instrument, and which indicates at the same time, to within the 20th of a second, the difference which existed primarily between the two instruments. Important applications may result from these conditions, by which the always hazardous transit of a chronometer from ship-board to land to test the rate during the voyage which the ship has just made, may be avoided. It is sufficient to adjust the seconds' hand of the chronometric compass with that of the chronometer on board, then to take the chronometric compass on shore, and to determine its coincidence with a regulator giving exactly the time of the landing place. The difference indicated by the instrument will give the rate of the chronometer since the last observation, taking into account necessarily the difference in longitude, at each of the places. The coincidence in question is obtained by turning the back part of the case either to right or left, according as the chronometric compass is faster or slower than the instrument with which you wish to adjust it; in other terms, by turning concentrically the two wheelworks of a watch with independent seconds. Persons familiar with this latter mechanism will understand in fact, that the movement one way will retard the action of one wheelwork on the other, by a duration proportional to the extent of the arc of displacement, and reciprocally, that the movement in the contrary direction will accelerate this action in the same proportion.

The anchor escapement usually employed by M. Redier, makes ten oscillations per second, he has successfully experimented with one giving twenty oscillations. Hence it is seen that its tendency is to approach as nearly as possible to continuous motion, a tendency the numerous experiments which he has made on the conical pendulum explain, and about which we shall say a few words.

The conical pendulum is so called because instead of moving in a plane perpendicular to the horizon, each of the points of its length describes a circle which continually increases in diameter from the point of suspension to its lower extremity, so that the space circumscribed by these points forms a cone. Huyghens is the first who occupied himself with it, but more in a theoretical, than a practical point of view; for none of those who afterwards wished to apply it, appear to have seized his idea of the mode of application.

A counter to tenths of seconds, making part of the collections of the Conservatoire appears to be the most ancient model extant of the employment of the conical pendulum such as it was understood and utilized by M. M. Bréquet, Foucault, Pecqueur, Cuel, Verité, Balliman, Saurendon, a few English artists, and lastly M. Redier.

The chief difficulty presented by the application of the conical pendulum resides in the suspension. A thread of metal breaks after a very short time of service, that with four knife edges is difficult to execute with sufficient precision. We give the preference

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on all points, to that with four springs employed by M. Redier, by means of a very ingenious arrangement, which, leaving perfect freedom to each couple of springs, maintains them precisely in the same position with respect to the pendulum. The rates which he has obtained by it are perfectly comparable to those which may be obtained by the ordinary pendulum.

The principal object proposed by M. Redier was the solution of the important problem of the transmission of exact astronomical time to distant places. It is by means of experiments made with the conical pendulum that he has arrived at the construction of his chronometric compass. It was known, from the experiments of M. Foucault, that the ordinary pendulum has the property of preserving its plane of oscillation. The experiments of M. Bravais have proved the conical pendulum to possess the same property. If on an horizontal plate, moveable round its centre, is placed a clock with conical pendulum, whose velocity is exactly one turn per second, and if the plate is made to turn in the same direction as the pendulum, the clock will lose. It will gain if the movement of the plate is in the contrary direction. One complete turn of the plate, in one direction or the other, will produce a retardation or gain of a second, of two seconds in two revolutions, &c., or of a fraction of a second exactly proportional to the fraction of revolution which the plate has made. Nothing therefore is easier than to establish the precise coincidence of time, between an ordinary regulator and a clock with a conical pendulum, or between two clocks of the latter kind; the distance between the two instruments being no longer an obstacle, thanks to the facilities given by electric communications.

If we have been fortunate enough to make ourselves understood in our too succint description of M. Redier's chronometric compass, the happy application of the same principle will be easily perceived, in the two cases.

M. Ch. Conet, Fils, exhibits a chimney-piece clock, with visible wheelwork, executed with a perfection of workmanship hereditary in his family. Although the pendulum is only long enough to give the half second, and receives two impulsions per second, with an escapement by Graham, the hand gives only the second, which produces, in the real acceptation of the word, an *escapement "á coup perdu."* The arbor of the seconds has two wheels, of which one is loose and bound to the fixed wheel by a spring, tightened by the movement which the latter makes at each double oscillation under the action of a remontoir. With the exception of the "coup perdu" respecting which our memory fails us, this arrangement of the remontoir with double wheel is not new; we are nevertheless unable to put a name to it. But what we do not remember to have seen elsewhere are the arrangements by means of which M. Ch. Conet has succeeded in reducing to a minimum the influence of the motive force on the disengagement of the remontoir, and in removing, in a great measure, the pendulum from this same influence. The disengagement only taking place for one out of two oscillations, this influence is necessarily reduced by half. It takes place in the middle of the impulse and in consequence at the most favourable moment, and not, as in the majority of cases, during the supplementary arc. Lastly, the detent upon which one of the branches of the remontoir rests, opposes only to the action of the pendulum, to effect the disengagement, the resistance of a spring whose tention may be regulated in such a manner as to have only the resistance absolutely necessary for the surety of the effect. If this instrument, otherwise so remarkable in its execution, does not justify in its strictest sense the expression *constant force* * which M. Conet, junior, has used to characterise it, we think we may say it is one of those which approaches it the nearest. It is a principle in horology to give to the pendulum, of fixed pieces, a weight sufficiently considerable to attenuate, by the inertia of its mass, the variations which may arise in the motive force, which, in this case, become less sensible in proportion as this mass is greater.

This is rarely done in portable instruments, in which the size is reduced as much as possible, and consequently that of the motive organ. One is thus logically led to diminish proportionally the mass of the balance whose rate varies necessarily with the variations of the motive force.

M. H. Robert has wisely preserved the heavy balance, and augmented the motive force, not by modifying the weight or thick-

* We only know two systems of clockwork to which this expression may be applied in its exactitude. One is by the founder of Brequet's establishment, the other by M. Verité, of Beauvais, who since his appearance at the exhibition of 1844, regulates, in all the instruments of the building in which the Tribunal of Beauvais sit, a great number of dials, without interruption to the admirable rate of performance. Since that time the fundamental arrangements of this clock have been applied to electric clocks, first by M. Verité, and afterwards by a certain number of other clockmakers.

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ness of the motive spring, but in making a greater length of this spring to act, during the same length of time; which he obtains in augmenting the angular velocity of the barrel;—in other terms, in modifying conveniently the number of teeth which constitutes the wheelwork.

In his astronomical instruments, M. Robert suppresses the special mechanism which allows several or all the hands of a timepiece to be rendered concentric; which in the most carefully made regulators always produces varying frictions which are transformed into variations in the rate of the instrument. Each hand has its dial and is mounted on the prolonged pivot of the wheel to which it belongs.

Other arrangements connected with the manufacture itself, allow him to establish without trial either the parallelism or perpendicularity of certain apparatus, and in consequence to construct instruments of precision at a remarkably low price.

M. H. Robert is the laureate of the Society for the encouragement of his instruments for civil use, in which he has during many years introduced several useful modifications. He has succeeded in giving to his seconds counters a remarkable degree of precision. That shown at the Exhibition registers photographically the different phases of a solar eclipse, in opening and closing automatically the passage of the light projected on a prepared paper. For a long time M. H. Robert has made sun-dials, and other arrangements for giving the time by the sun. At the present moment he and his son are completing an instrument whose precision is at least tenfold greater than that of all known sun-dials. An hour chart, which is a necessary appendage, allows all problems of hour angles to be graphically solved, in a moment and without calculation, especially the following:—

To find the time,—the altitude of the sun, and the latitude of the place of observation being given.

To find the latitude by means of two observations of the solar altitude, &c.

The solution of the latter problem interests seamen, especially as it dispenses with long and tedious calculations.

(To be Continued.)

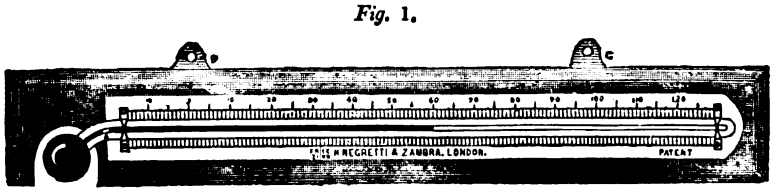
MERCURIAL MAXIMUM THERMOMETERS.

Professor John Phillips suggested the introduction of a small portion of air into an ordinary thermometer, so as to cut off about half an inch of the mercurial thread near its end in the tube. This forms a maximum thermometer, when the stem is arranged horizontally. The isolated portion is pushed forward by expansion and is left in this position when the mercury contracts. The end remote from the bulb shows on the scale the maximum temperature.

When made, as by Mr. Casella, with a capillary tube so fine that the attraction arising from capillarity overcomes the force of gravity, and prevents the mercury falling to the end of the tube when the instrument is inverted, it forms a very serviceable thermometer, quite portable, and suitable for use on board ship. In such a tube a smart shake from a swing of the hand, is required to bring the detached portion back to the column, so as to set the instrument for future observation; no ordinary motion would move it. When the thermometer has not this peculiarity, the mercury will flow to the end, if declined; and in this state is not at all a satisfactory instrument, as the air is likely to be displaced, and a great deal of tact is requisite to again get it to divide the column suitably. It has been found, that the air bubble disappears in a few years, by oxidation and by diffusion with the mercury, so that the instrument becomes defective and uncertain in practice, results which led to the construction of the self-registering mercurial maximum thermometer, invented and patented by the enterprising opticians, Messrs. Negretti & Zambra. It has been before the public about twelve years; we may therefore, now, safely speak of its merits.

It consists of a tube of mercury fitted on an engraved scale, as shown in (*fig.* 1). The

Fig. 1.



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thermometer tube above the mercury is entirely free from air; and at the point (A) in the bend above the bulb, is inserted and fixed with the blow pipe, a small piece of solid glass, or enamel, which acts as a valve, allowing mercury to pass on one side of it when heat is applied; but not allowing it to return when the thermometer cools. When mercury has been once made to pass the contraction, which nothing but the expansive force of heat can effect, and has risen in the tube, the upper end of the column registers the maximum temperature. To return the mercury to the bulb, we must apply a force equal to that which raised it in the tube; the force employed is gravity, assisted when necessary by a little agitation of the instrument.

In using this thermometer it must be suspended by means of two brass plates (B, C,) attached for that purpose, in such manner that it hangs raised up a little at C, and so placed that it is in the shade, with the air passing freely to it from all sides; then, on an increase of heat, the mercury will pass up the tube as in an ordinary thermometer, and continue doing so as long as the heat increases. On a decrease of heat, the contraction of mercury will take place *below* the *bend* in the tube, leaving the whole column of mercury in the tube, thus registering the highest temperature, and showing such till the instrument is disturbed.

To prepare the instrument for future observations, remove and hold it perpendicularly, with the bulb downward, and then shake it. The mercury will then descend in the tube, and indicate the temperature of the air at that time; and, when again suspended, is prepared for future observation.

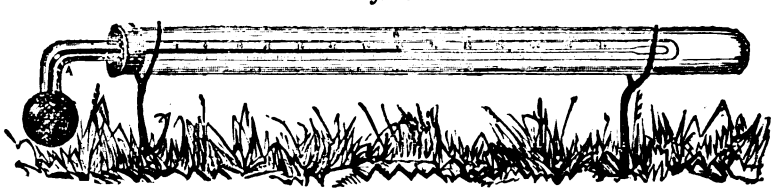
After the temperature has attained a maximum, there will be, with a decrease of heat, a slight contraction of mercury in the tube —as well as of that in the bulb—and, hence, doubts have arisen as to the accuracy of the registration; but calculation shows and critical trial has proved, that the greatest daily range of temperature will not produce an error large enough to be appreciable on the scale.

The degrees are generally divided on the stems of these thermometers, but their frames of course bear a scale as well. The makers have various styles of framing in wood, metal, porcelain, and even glass. Each material is eligible according to requirements. Porcelain scales, having the marks *etched* upon them by acid and permanently blackened and baked in,—by a process for which these makers have a separate patent,—will be found very serviceable, as they do not corrode or tarnish by exposure to any kind of weather; while any amount of dust and dirt can readily be cleaned off.

The chief recommendation of this thermometer is its simplicity of construction, enabling it to be used with confidence and safety. Of no other maximum thermometer can it be said that it is impossible to derange or put it out of order; hence as regards durability it surpasses all others. Nothing short of actual breakage can cause it to fail. Hence it is the most easily portable of all self-registering thermometers, an advantage which renders it suitable for travellers, and for transmission abroad. In the year 1852, the British Meteorological Society reported this thermometer to be "the best which has yet been constructed for maximum temperature, and particularly for sun observations." Since then eleven years have elapsed and it is still without a rival.

Fig. 2 shows the arrangement of Negretti & Zambra's maximum thermometer, for registering the greatest heat of the sun's direct rays, hence called a *solar radiation thermometer.*

Fig. 2.



It has a blackened bulb, the scale divided on its own stem, and the divisions protected by a glass shield. In use it should be placed nearly horizontally, resting on Y supports of wood or metal, with its bulb in the full rays of the sun, resting on grass, and, if possible, so that lateral winds should not strike the bulb.

This instrument has been improved by Messrs. Negretti & Zambra into the *vacuum solar radiation thermometer* as illustrated by *fig.* 3.

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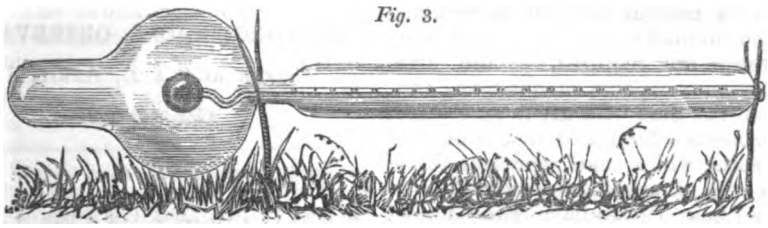
Fig. 3.



This consists of a blackened-bulb radiation thermometer, enclosed in a glass tube and globe, from which all air is exhausted. Thus protected from the loss of heat which would ensue if the bulb were exposed, its indications are from 20° to 30° higher than when placed side by side with a similar instrument with the bulb exposed to the passing air. At times when the air has been in rapid motion, the difference between the reading of a thermometer giving the true temperature of the air in the shade, and an ordinary solar radiation thermometer, has been 20° only, whilst the difference between the air temperature and the reading of a radiation thermometer in vacuo has been as large as 50°. It is also found that the readings are almost identical at distances from the earth varying from six inches to eighteen inches. By the use of this improvement, it is hoped that the amounts of solar radiation at different places may be rendered comparable; hitherto they have not been so; the results found at different places cannot be compared, as the bulbs of the thermometers are under very different circumstances as to exposure and currents of air. Important results are anticipated from this arrangement. The observations at different places are expected to present more agreement. In *fig.* 3, the vacuum bulb is, we should imagine, wrongly shaped. It should be spherical (?), or as nearly as possible so, in order to maintain uniformity of construction, if for no other reason.

HISTORY OF THE PROBLEM OF FINDING THE LONGITUDE.

The growing greatness of this nation, and the rapid development of its commercial relations made a study of astronomy absolutely nccessary, not as a matter of pure science, or of abstract speculation, but with a view to the observations of the fixed stars and planets for the purposes of navigation.

Any one acquainted with the astronomical methods in use two centuries ago, will appreciate the difficulties which mariners had to encounter in a voyage to the East or West Indies, and the urgent necessity which existed for the introduction of better instruments and better methods. And it fortunately happened that this age was an age of great men, of giants in intellect who could lead the advancing intelligence of the time, and could alternately urge and assist the government of the country by advancing schemes suitable for the scientific and social, as well as the commercial interests of this country. It was the age of Newton, Boyle, Hooke, and Wren, not to mention many others who were quite prepared to take every advantage of the continental scientific discoveries bequeathed to them by that immediately preceding, and above all, and as a natural consequence, it was the age which gave birth to the Royal Society.

One of the first fruits of this intellectual activity was the establishment of the Greenwich Observatory by the government, with the expressed object of advancing the art of navigation, or of enabling the mariner to navigate the ocean more safely, and to find by observation and calculation his position upon it at any given instant.

The duty of the first Astronomer Royal was defined to be—"to rectify the tables of the motions of the heavens and the places of the fixed stars in order to find out the so-much desired longitude at sea, for perfecting the art of navigation."

The art of chronometry was equally with pure science, in its infancy. It was not till the impulse was given in the early part of the eighteenth century, by the large reward offered by the British government for the discovery of the longitude at sea, that the series of chronometrical improvements was begun, which, commencing with Harrison, was taken up successively by Arnold, Earnshaw, and a multitude of artists, extending to the present day, who have made the chronometer to become an instrument of wonderful precision, and a worthy attendant on the noble science of Nautical Astronomy, which has been by similar well-directed efforts

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brought to its present state of perfection. To make the method of lunar distances applicable, there are required, in the first place, instruments capable of observing the distance and the time with great precision; and in the second, tabulated places of the moon and stars, which shall represent their true places with all attainable accuracy.

Hansen's Lunar Tables have reduced now to the most insignificant limits the residual errors of the lunar theory; and certainly within the errors incidental to meridional observation with first-rate instruments, and very far within the limits of accuracy of observations with the sextant.

Hansen's Tables are practically perfect for all the purposes of navigation, and the great nautical problem of finding the longitude at sea is now completely solved.—*Extracted from Professor Main's Address to the Royal Astronomical Society in* 1860.

Correspondence.

To the Editor of the HOROLOGICAL JOURNAL.

Wakefield, *April 13th*, 1863.

Sir,—In reading the translation of a French article on the International Exhibition of 1862, I find ascribed to M. A. Brocot an escapement, the pendulum of which "only receives impulsion on one side," and which accordingly marks seconds with what is commonly called a half-seconds pendulum. I did not see Mons. Brocot's escapement, but I saw one that gave similar results eight years ago. It was an adoption of the chronometer wheel to the pendulum, made originally by a Scotchman, in Dundee, and latterly by Mr. W. F. Evans, Handsworth, Birmingham.

I shall be glad to see the above in the Journal, as a desire to "give honour to whom honour is due," alone prompts me to address you. I remain, yours truly,

A COUNTRY MEMBER.

[The two things mentioned are essentially different. The one is the application of the detent escapement to the crutch of a clock, being connected with its pendulum by the usual pin and giving impulse as usual in one direction only. The other is an escapement, devised for the express purpose of marking full seconds by the beats of a half-second's pendulum, and is simply an improvement in the parts of a very old contrivance, which will be recognized by experienced clockmakers if called a loose pallet anchor escapement.]

METEOROLOGICAL OBSERVATIONS

Taken at 9 A.M., APRIL, 1863.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	°	°	°	°				
1	30·179	40	38	52	32·5	ESE	2	m	cb, bm
2	30·123	43	40	54	35	E	2	b	bm
3	30·273	44	41	55	38	Calm.	0	f	m, cb
4	30·026	48	45	58	41	W	4	cb	o, p, cb
5	29·890	47	44	54	40	W	3	o	c, bc
6	29·646	51·5	47	53	46·5	SSW	8	o	c, p, cb
7	29·490	45	42	55	42	W	3	b	cb, ph, c
8	29·720	46	42	54	37	SW	4	c	r, o
9	29·791	53	51	53	45·5	SSW	2	c	o, r
10	29·830	54·5	53	56	51	SSW	3	o	o
11	29·813	54	51	61	51	NW	1	c	cb
12	29·950	52	48·5	59	48	NE	2	c	cb
13	30·014	52·5	49	62	45	SE	3	c	b, o
14	29·977	48	45·5	59	44	E	2	o	o, bc,
15	30·024	47	45	56	41	SW	2	mc	bm, bc
16	30·024	53	50	57	47	NW	1	c	c, o, b
17	30·156	52	48·5	64	47	NW	3	b	bc, o
18	30·251	55	52	64	50	NNW	4	o	bc, b
19	30·230	48	45	63	42	SE	2	cm	b
20	29·961	51	47·5	63	45	SW	2	cm	cb, b
21	29·904	50	46	64	41	W	4	b	cp, bc
22	29·700	55	52	57	50	WSW	7	o	cp, b
23	30·075	49·5	44·5	60	42·5	NW	5	bc	bc, b
24	30·433	47	42	58	39·5	NNW	4	b	o, cb
25	30·324	54	50	59	46	NNW	5	c	cb, b
26	30·300	54	49	65	45	NW	5	bc	b
27	30·123	55·5	48.5	65	45	WNW	4	b	cb
28	29·882	50	45	63	47	W	5	o	pcb, bc
29	29·862	46	41·5	57	41	NNW	4	c	opq, bc
30	30·120	44	42	51	38	NNE	6	o	qhrr, bc
	30·003	49·7	46·2	58·4	43·4		3.4		Mean.

REMARKS.

The greatest atmosphere pressure was 30·44 inches at 10 a.m., 24th, and the least 29·44 inches at midnight, 6th; so that the difference of pressure amounted to one inch of mercury.

Rain fell on 10 days, during about 20 hours, to the amount of 0·71 of an inch, four tenths of which fell on the 30th.

According to the table the wind was from the N on 7 days; E, 5; S, 5; W, 12; and one day was calm.

On the 6th a SWly gale prevailed; and early in the morning of the 22nd the wind reached the force of a gale from WSW. During the last three days strong winds blew from NW veering to NE with squalls accompanied with rain and hail showers.

The pressure, temperature, and winds agree remarkably with the observations of April 1862; but the rain was very much

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deficient. The month was very fine and dry, with the temperature about two degrees above the average.

The past Winter.—"In the last quarterly report it was shown that the mortality was high; and the returns since obtained furnish equal evidence that in the first quarter of the present year the public health has not improved. The cold weather of November was fatal to many persons, and the effects of that month were probably not unfelt after the year had closed; and also causes that were proper to last quarter rendered it more unfavourable to health than many seasons that were less remarkable for their mildness.

A winter remarkably "mild" has also been remarkably unhealthy. The deaths in England in the three months that ended 31st March were 128,524, against 122,192 in the same period of last year, which supplies an example of average health in winter, and may be taken as means of comparison. It will be an approximation to the truth to state that people died in the quarter at the rate of 20,000 in a year, whose lives would have been saved if epidemics or atmospheric causes of a nature unfavourable to health had not been in greater force than usual. The rate of mortality was 2·546 per cent., the average being 2·498. In London a sudden interruption of early spring weather, by a fall in the temperature, occurred in March, and was followed by an extraordinary increase of mortality, which continued many weeks after the apparent cause had ceased, and warm weather had resumed its sway."—*Registrar General's Return for the First Quarter of* 1863.

Indications for June.

The sun attains its greatest north declination on the 21st. At London the length of the middle day extends to 16h. 30 m. The average height of the barometer is 29·97, with a mean range of 0·8 inch. The *day* temperature is 70°, the *night* 50°,—on the average. The prevalent winds are from w to N. It is considered a dry month, but the average rainfall is 1·7 inches for 12 rainy days.

ABRIDGMENTS OF
SPECIFICATIONS OF PATENTS
RELATING TO WATCHES, CLOCKS, AND OTHER TIMEKEEPERS.

(*Continued from page* 106.)

1852, October, 4.—No. 214.

KENNEDY, THOMAS.—"Improvements in obtaining and applying motive power, which improvements or parts thereof are applicable to timekeepers and clockwork, and for measuring and registering the flow of water and other fluids and aeriform bodies." According to one modification, the apparatus consists of a cylinder, closed at each end, and fitted with a piston working fluid tight, or nearly so, within it, the rod of the piston being passed through a stuffing box in the cylinder cover. A cord from the rod is passed over a pulley having at the other end a counter-weight sufficient to balance the weight of the piston and its moving connections. The motive fluid is conducted to the apparatus by a pipe, which diverges into two branches, each fitted with a valve of similar action. These valves, from which pipes to the upper and lower parts of the cylinder pass respectively, work together so that when one is open to admit water to the cylinder beneath the piston, the other is closed to shut off the communication between the supply pipe and the opposite end of the cylinder above the piston, while at the same time the latter opens up a free discharge for the fluid above the piston. Both discharge outlets from the valves are combined into a single discharge pipe. There is a pin on the pulley, so set that, when the piston arrives at either end of its stroke, it (the pin) elevates a tumbler which is loose on the drum shaft as a centre, and the tumbler then falls over on the other side of its vertical centre of motion. In its fall it acts on the lever of the two connected valves, which are thus simultaneously and instantaneously reversed. A continuous reciprocatory action of the piston is thus kept up. The power so obtained may be taken from the apparatus in various ways, either from the piston rod, or the pulley or drum, or other moving detail. Among other things the patentee applies the above arrangement or a modification thereof to time-keepers or clockwork.

[Printed, 11½*d.*]

1852, October 9.—No. 324.

RESTELL, THOMAS.—1. Relates to escapements, and consists in the production of an alternate motion from the continuous revolution of a cam, so made that the axis passes somewhat out of the centre of some or all of the circular arcs which form the outer edges of the said cam, this cam actuating a lever in which are fixed two studs or pins, between which the cam acts. In connection with the said lever when used in giving impulse to the balance, instead of employing both a detent and a lifting spring, the patentee only uses one of these, but of greater sensibility, which is affixed to the end of the lever. Complete circular cams may also be used.

2. Relates to the employment of the said cams to roasting jacks.

3. Relates to the employment of a slide in conjunction with a circular arm of compound metals, whereby the balance spring is lengthened or shortened for the purpose of compensation. This is effected by the action of the circular arm upon a lever, to the end of which the spring is affixed, the slide being used to produce the necessary length or active power in the circular arm. The slide acts on a curved part of the lever, and the part to which the spring is fixed is also curved.

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4. Relates to a mode of using pallets in a lever watch, so that there shall be upon the one end thereof no locking of any kind, the escape wheel being detained only upon the other side of the same, the balance affecting the lever or lock upon which the pallets are fixed only at its second vibration.

3. Relates to a construction of clocks, in which the use of a pendulum is dispensed with, by the substitution of a ball or balls rolling on wire and returning again to the place they started from, so that each ball is again conveyed to the power producing motion, and thus maintains the action of the clock.

[Printed, 1*s.* 2½*d.*]

1852, October 19.—No. 438.

HARCOURT, JOSEPH, and HARCOURT, WILLIAM.—*Void by reason of notice to proceed not having been given within the time prescribed by the Act.* The Provisional Specification states the invention to be, "The application of porcelain, glass, or earthenware to articles in which or for which those materials have never heretofore been used." The only articles mentioned as relating to clocks are, "spires for bird cages and clock cases."

[Printed, 2½*d.*]

1852, November 11.—No. 706.

LUEDEKE, ERNST.—*Void by reason of notice to proceed not having been given within the time prescribed by the Act.* The patentee in his Provisional Specification says, "I intend by the use of a pendulum, double wheel, and springs to produce vibration; such vibration being first produced by the springs, and kept up by the concurrent action of the pendulum, wheel, and springs, which reciprocate, or in other words give and receive, impulsive power from each other." He also states that the invention would, in fact, be perpetual motion if no part thereof should be displaced, broken, or worn out by friction.

[Printed, 2½*d.*]

1852, November 13.—No. 730.

PHILCOX, GEORGE.—"Improvements in marine chronometers and other timekeepers." The balance is made with volute duometrical springs, being another application of the double spring explained in the patent (No. 11,177) for the cylindrical double spring. The patentee obtains half seconds with the fifth wheel, or with a nine cut lever. In the escapement the impulse is given in the line of centres. The staff is jewelled with a ruby or other stone, instead of a hollow roller.

[Printed, 6½*d.*]

1852, November 16.—No. 770.

O'KEEFFE, JOHN.—*Void by reason of notice to proceed not having been given within the time prescribed by the Act.* The Provisional Specification states the object to be as follows:—"To make watch cases out of metal plates or sheet metal by means of screw press (somewhat similar to the ordinary screw copying press) furnished with internal and external dies, the latter so constructed as to correspond in shape and size to the internal and external dimensions of the part of the case to be formed when completed."

[Printed, 2½*d.*]

1852, November 30.—No. 911.

ADDISON, JOHN.—*Void by reason of notice to proceed not having been given within the time prescribed by the Act.* The invention is for ascertaining the hour of the day by means of a pocket sun dial, and the Provisional Specification states that, "It can be constructed of tin, german silver, or any other metal, or of porcelain, and can be regulated by the metalic plate at the back of the dial, with as much accuracy as the most expensive made watch; and this is necessary, as when the days begin to shorten it loses at the rate of three minutes every two days, and as the days lengthen it gains three minutes in two days. This plate is 2½ inches long by ½ inch broad, and attached by a screw to the centre of the dial on which the plate or regulator is moved. On the top of this the handle is fixed, which is done by a small pin made to fit loosely so as to form a pivot for the handle to move upon, and which allows it to be held without occasioning the slightest leverage, which would otherwise be the case, and thereby prevent the hour being accurately ascertained.

Previous to returning the dial to the pocket, the hand is turned upon its hinge to the back of the dial, and the handle is turned on its pivot so as to rest on the plate or regulator. This dial can also be used for nautical purposes."

[Printed, 4½*d.*]

1852, December 14.—No. 1051.

WEBB, JOHN.—The invention consists in embossing or engraving, or producing the resemblance of embossed or engraven designs on the surfaces of enamel watch dials. The patentee draws a design on an ordinary enamel dial, and then applies some acid to the parts intended to be sunk or cut in. After the acid has remained on a sufficient time, the dial is cleansed with oil, and polished in the usual manner.

[Printed, 2½*d.*]

(*To be Continued.*)

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THE BRITISH HOROLOGICAL INSTITUTE.

HALF-YEARLY MEETING OF THE MEMBERS.

THE Half-yearly Meeting of the Members of the British Horological Institute took place on the Evening of the 24th June, for the purpose of receiving the Half-yearly Report and Financial Statement, and also for the Election of the Council and Officers of the Institute. We are unable to give an account of the proceedings in the present number. It will however appear in the August number, together with an account of the Special General Meeting held on the 19th June. The following is the

"REPORT OF THE COUNCIL FOR THE HALF-YEAR ENDING JUNE 24, 1863.

"In presenting the Tenth half-yearly Report of the proceedings of the British Horological Institute, your council have first to remark an improvement in the finances and prospects of the Institute. A rigid adherence to economy has enabled them to recover ground lost in the early period of the Institute's history, and experience has pointed out the proper method of dealing with its income.

"As compared with the corresponding period of last year, there is an increase of sixteen members. Forty-two have joined since the last Annual Meeting, twenty-six have retired and three have been lost by death.

"Measures are in progress for the improvement of the Journal of the Institute, but the Council beg to point out the necessity of help from the members, especially in respect of articles of interest for insertion.

"Weekly conversational meetings have been arranged for the members and their friends, and several subjects of importance have been brought under discussion.

"The subject of Standard Horological Gauges has been considered by a sub-committee, who have come to the unanimous conclusion that the recommendation of the Parliamentary Committee should be followed out in the construction of a gauge for horological uses. The subject has been discussed in the Journal, but the chief point recommended is the use of the French metre as the unit. The Council would be glad to receive suggestions for the specific form or forms of gauges, most suitable for our especial purpose.

"A successful attempt has been made to form a nucleus of a Prize Fund, especially in connection with essays on horological subjects. It is proposed that this fund shall be entirely distinct from the general income of the Institute, and as soon as a sufficient amount has been subscribed, it is proposed to call a meeting of the subscribers to determine upon further proceedings, and arrange the details of the ultimate plan.

"A strong desire has been expressed by several members, that diplomas or certificates of skill should be awarded by the Institute. It is evident that this is desirable if it can be accomplished satisfactorily, provided the documents in question would carry authority with the trade and the public. Any society which issues such certificates must have extensive influence and be liberally supported. The labour of examination would involve the payment of fees to the examiners, and collateral expenses would require funds to meet them. The subject is worthy of the careful consideration of the members, and the Council venture to express a hope that so important an object will induce the members to strengthen the Institute in numbers, and in funds, as a first means to its attainment.

"The Annual Festival was successfully held on March 9th under the presidency of Sir Samuel Morton Peto, Bart., M.P., and was attended by a number of gentlemen well known in the scientific world.

"In conclusion your Council would express an earnest hope that those who believe in the excellence of the avowed objects of the Institute will endeavour to forward them to the utmost of their power. They feel bound to express their desire to give place at any time to more active and influential members of the trade. The work is not for private interest or honour, but for the substantial good of the profession and the public, and your officers would be among the first to hail the permanent establishment of the British Horological Institute on a firm and honourable basis entirely regardless of their respective position of individuals."

ON THE PERFORMANCE OF CHRONOMETERS.

BY JOHN HARTNUP, ESQ., F.R.A.S., &c.

Director of the Liverpool Observatory.

The extensive use made of the chronometer for finding the longitude of a ship at sea has induced me, for some years past, to make the study of the various peculiarities connected with its performance one of my principal duties at the Observatory. A faithful record has been kept of the performance of all timekeepers which have passed through our hands from the day that the Observatory was opened to the present time, and

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abstracts of results have, from time to time, been published. These abstracts have, however, always related to the performance of chronometers on shore; no account has been given of their errors at the terminations of voyages of different lengths. The delay in giving such information has been caused by the difficulty in obtaining a sufficient number of examples to allow conclusions of a trustworthy nature to be drawn from them. When ships' chronometers are sent to the Observatory it is, of course, optional on the part of the Captain as to whether he furnishes us with the *error* and *rate* supplied to him at the last port from which he sailed, and in a large proportion of cases this information has not been available to us; but in all cases in which it could be obtained we have tabulated the results, and we have now on record the error in longitude by chronometer for between one and two thousand voyages, ranging in time from a few weeks to twelve months and upwards.

In order to render the information thus obtained available for comparison, we have taken averages at intervals of two or three months; and then, by interpolation, the mean errors have been found for each month, from one to twelve inclusive. In the following table the first column shews the length of voyages in months, the second column contains the average error of longitude in minutes of arc, or in geographical miles on the equator, as deduced from 1,700 chronometers; the remaining columns shew the average error of the best ten, second best ten, third best ten, &c., in one hundred, the last column shewing the mean error of the worst ten in one hundred.

TABLE I.

ERROR OF LONGITUDE IN GEOGRAPHICAL MILES ON THE EQUATOR DEDUCED FROM 1700 CHRONOMETERS.

Length of Voyage.	Average Error deduced from 1700 Chronom^{rs}.	The Best 10 in 100.	Second Best 10 in 100.	Third Best 10 in 100.	Fourth Best 10 in 100.	Fifth Best 10 in 100.	Sixth Best 10 in 100.	Seventh Best 10 in 100.	Eighth Best 10 in 100.	Ninth Best 10 in 100.	The Worst 10 in 100.
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
1 month	6	0	1	1	2	3	4	5	7	9	25
2 months	14	0	2	4	5	7	9	11	15	24	62
3 months	23	1	3	6	9	12	15	18	25	41	101
4 months	33	1	4	8	13	17	22	28	36	61	143
5 months	44	1	5	10	17	22	29	39	49	84	187
6 months	56	2	6	13	21	28	37	50	64	108	233
7 months	69	2	8	16	25	34	46	62	80	134	280
8 months	82	3	10	19	30	41	55	74	98	159	328
9 months	95	3	12	22	35	48	65	86	117	184	376
10 months	108	4	14	26	40	56	75	98	137	208	425
11 months	122	4	16	30	46	64	86	111	157	233	474
12 months	136	5	18	34	52	72	97	124	178	258	524

For the 1,700 chronometers employed the average error for a voyage of one month is 6 miles, but the error increases with time in an increasing ratio; for three months it is not 18, but 23 miles; for six months 56 miles; for nine months 95 miles, and for 12 months 136 miles. For the best fifty in one hundred the average error for one month is 1 mile, and for twelve months 36 miles; while for the worst fifty in one hundred, the average error for one month is 10 miles, and for twelve months 236 miles. The best ten in one hundred, as will be seen by the table, were almost perfect, the errors ranging from 0 to 5 miles in voyages of from one to twelve months, while for the worst ten in one hundred the errors range from 25 to 524 miles for voyages of the same length. In a large majority of cases these discordant results arise, not so much from the difference of quality in the instruments, as from the method which is almost universally employed of obtaining the rates on shore, and calculating the errors on Greenwich mean time at sea.

The rates of all chronometers are more or less affected by change of temperature, and, in addition to this, they are often found to increase or diminish with great regularity from one month to another, but the practice generally adopted is to use the same rate for all climates and for long periods of time. I have, therefore, been induced to make considerable alterations in the method of testing and giving the rates of chronometers, with

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the view of ascertaining the value of these corrections more accurately and of rendering the application of them more simple. The following example, taken from the records of the Observatory, and copied on one of the forms which we now use, will illustrate the method, and the calculations which follow will shew its efficiency:—

TABLE II.

ERROR AND RATE OF CHRONOMETER No. 1718.

DATE.	ERROR ON GREENWICH MEAN TIME. FAST.	ERROR ON GREENWICH MEAN TIME. SLOW.	MEAN DAILY RATE. Gaining.	MEAN DAILY RATE. Losing.	Mean Temperature Fahrenheit.	Extreme difference of Rate between any two days.
1862.	H. M. S.	H. M. S.	S.	S.	°	S.
October 25	0 1 59·2	.. ..	..	..	..	..
,, 27	0 2 1·0	.. ..	..	..	..	..
,, 28	.. .. 1·8	.. ..	..	..	..	..
,, 29	.. .. 2·5	.. ..	..	..	..	..
,, 30	.. .. 3·3	.. ..	..	..	..	..
,, 31	.. .. 4·4	.. ..	..	..	..	..
November 1	.. .. 5·4	.. ..	0·9	..	55	0·4
,, 8	.. .. 7·9	.. ..	0·4	..	70	0·5
,, 15	.. .. 3·3	.. ..	..	0·7	85	1·1
,, 22	.. .. 14·5	.. ..	1·6	..	70	0·4
,, 29	.. .. 29·5	.. ..	2·1	..	55	0·3
December 6	.. .. 42·6	.. ..	1·9	..	70	0·6
,, 13	.. .. 47·6	.. ..	0·7	..	85	0·7
,, 20	0 3 5·2	.. ..	2·5	..	70	0·7
,, 27	.. .. 27·1	.. ..	3·1	..	55	0·2
1863.						
January 3	.. .. 47·5	.. ..	2·9	..	70	0·9
,, 10	.. .. 57·6	.. ..	1·4	..	85	0·5
,, 17	0 4 18·9	.. ..	3·0	..	70	0·4
,, 24	.. .. 47·0	.. ..	4·0	..	55	0·4

From the preceding record it will be seen that from the week ending November 1, 1862, to that ending January 24, 1863, the temperatures to which the chronometer was exposed were 55°, 70°, 85°, 70°, 55°, and so on in succession; it therefore requires five weeks for a complete series of rates in the above-named temperatures, and these were obtained between October 25 and November 29.

Now the rate in 55° for the week ending November 1 was nine-tenths of a second gaining, and in the same temperature for the week ending November 29 it was gaining two seconds and one-tenth; the difference is one second and two tenths, which divided by four, the number of intervening weeks, gives three-tenths of a second for the weekly increase of gaining rate.

We therefore have for November 15—

(For the week ending November 15) S.
Mean daily rate losing 0.7 in 85°.
(From weeks ending Nov. 8 and 22)
Mean daily rate gaining 1.0 „ 70°.
(From weeks ending Nov. 1 and 29)
Mean daily rate gaining 1.5 „ 55°.
And weekly acceleration of gaining rate 0.3.

With the above data the following rates have been calculated by simply adding 0·3 for each week subsequent to November 15.

CALCULATED RATES.

1862.	55° S.	70° S.	85° S.	1862.	55° S.	70° S.	85° S.
Nov. 15,	+ 1.5	+ 1.0	− 0.7	Dec. 27,	+ 3.3	+ 2.8	+ 1.1
22,	+ 1.8	+ 1.3	− 0.4	1863.			
„ 29,	+ 2.1	+ 1.6	− 0.1	Jan. 3,	+ 3.6	+ 3.1	+ 1.4
Dec. 6,	+ 2.4	+ 1.9	+ 0.2	„ 10,	+ 3.9	+ 3.4	+ 1.7
„ 13,	+ 2.7	+ 2.2	+ 0.5	„ 17,	+ 4.2	+ 3.7	+ 2.0
„ 20,	+ 3.0	+ 2.5	+ 0.8	„ 24,	+ 4.5	+ 4.0	+ 2.3

The sign + means that the rate is gaining, and the sign − that it is losing.

To find the error of this chronometer on Greenwich mean time for each week subsequent to November 15, nothing more is necessary than to take the rate from the above table, corresponding to the temperature to which the chronometer was exposed, multiply this by seven, and add the amount thus obtained to the error on Greenwich mean time for the preceding week. In this way the following errors on Greenwich mean time have been obtained and compared with those found by observation from November

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22, 1862, to January 24, 1863, and had the chronometer been at sea for the eight weeks ending January 24 precisely the same calculations might, of course, have been made.

TABLE III.

ERRORS ON GREENWICH MEAN TIME.

NOVEMBER 15TH, 1862.—FAST 2m. 3·3s.

DATE.	Temperature.	Calculated.	Observed.	Difference.
1862.		H. M. S.	H. M. S.	S.
November 22	70	0 2 12·4	0 2 14·5	2·1
,, 29	55	0 2 27·1	0 2 29·5	2·4
December 6	70	0 2 40·4	0 2 42·6	2·2
,, 13	85	0 2 43·9	0 2 47·6	3·7
,, 20	70	0 3 1·4	0 3 5·2	3·8
,, 27	55	0 3 24·5	0 3 27·1	2·6
1863.				
January 3	70	0 3 46·2	0 3 47·5	1·3
,, 10	85	0 3 58·1	0 3 57·6	0·5
,, 17	70	0 4 24·0	0 4 18·9	5·1
,, 24	55	0 4 55·5	0 4 47·0	8·5

By the application of these corrections the above table shews that the error in a ship's longitude by this chronometer would have scarcely exceeded the width of the Mersey during the eight weeks voyage; but if the corrections for temperature and acceleration of rate had not been applied, and the seven-tenths of a second losing rate found for the week ending November 15 had been used, then by exposing the chronometer to a temperature of 55° for the eight weeks, the error in longitude by chronometer would have been nearly a degree; and if, on the other hand, the rate for 55° had been used, and the chronometer exposed for the eight weeks to 85°, the error would have been only a few seconds. In the former case the defective thermal compensation and acceleration of rate both tend to increase the error, and at the end of the voyage the chronometer would have stood as one of the worst in Table I, while in the latter case these corrections nearly neutralize each other, and, consequently, the chronometer would have stood as one of the best in Table I. It is, therefore, not surprising, when these corrections are neglected, that the longitude by chronometer at sea should be found to be so uncertain. In the example given it will be observed that the rate changed from two distinct causes, one of which depended on the temperature, and the other on time. The correction for temperature is frequently found to remain sensibly the same for many voyages in succession, but that for time is not so permanent, and it should, therefore, be checked as frequently as possible at sea during long voyages. In some cases the latter correction is so small, that it may be neglected altogether, and the correction for temperature is then the only one that need be applied to the rate. I am not aware of any previous attempt having been made to give the rates in such a way as to admit of these corrections being applied, and the method has been devised, after long and careful consideration, as the best under all circumstances for the guidance of the mariner. By alternately exposing the timekeepers to the two extreme and the middle temperatures to which ships are generally exposed at sea, the average rate, if used without regard to the corrections, is the best *average* rate that can be given, and when such information falls into the hands of the intelligent navigator, he will make use of it in a way that cannot fail to be of great advantage to him in finding the position of his ship at sea. The last column, in which the greatest differences of rate between any two days for each week are given, shews at a glance whether the chronometer is in good condition. In the best made timekeepers these differences generally range from three or four tenths of a second to one second, or a little more; but when irregularity in the performance commences these differences get larger, and this is a warning that the instrument should be cleaned, repaired, or its delicate adjustments examined, one or more of which may have become deranged. In the example selected the chronometer is de-

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cidedly a well-made instrument, but the thermal adjustment, for temperatures between 55° and 85°, is not so perfect as it might be made; it is, however, but little if at all worse than the average. The chronometer is also nearly new, and hence the tendency to gradually go faster from week to week. It would, of course, be better to keep such a chronometer on shore for a few months till the tendency to gain had become smaller, and for the maker to try to improve the thermal adjustment, and this is what we always recommend; but it is impossible to prevent their being taken to sea in this, and even in a very much worse condition, and whatever pains may be taken by the makers, perfection cannot be attained; we have, therefore, adopted this method of giving the rates, in order that the mariner may have the necessary data supplied to him for calculating the errors arising from such imperfections as may be found to exist.

When the Observatory was first opened the general impression was that giving accurate time to the Port was all that would be required; but as it was well known that the rates of some timekeepers at sea differed from the rates obtained on shore, we were instructed to receive them at the Observatory, in order, if possible, to find out the cause of these differences. In the first hundred chronometers that I tested in the two temperatures 40° and 60°, the average change of rate was seven seconds a day, and in some the rates were affected by this change to the scarcely credible amount of one minute of time and upwards, so that there were some chronometers then in use in which a change of temperature of 20° would produce an error of forty minutes of time, or ten degrees in a ship's longitude, in a voyage of forty days. From the time of that discovery we have made it a rule to subject all timekeepers which pass through the Observatory to such changes of temperature as would shew these large defects in the thermal adjustment, and this has led to very great improvements being made in a large number of chronometers.

The aid that we have rendered to navigation for many years past has therefore been mainly confined to that of giving accurate time to the Port, and pointing out defects in instruments, and thereby causing such defects to be removed: but the facilities which we now have by the addition of the new chronometer-room, have enabled me to give the rates in the way described, and for the object named in the example submitted.

HOROLOGY AT THE INTERNATIONAL EXHIBITION, LONDON, 1862.

By M. BOQUILLON.

Translated from Annales du Conservatoire Impérial by J. S. Harding.

(*Concluded from page* 113.)

If the exposition of M. Oudin-Charpentier was only composed of pieces, which attract more particularly the attention of the mass of visitors by the richness and good taste of the ornaments; if he had only croix-montres of various styles, made to order for crowned heads, we should pass him over in the most complete silence, because we should not see in such pieces that kind of progress which it is our mission to look for and to point out to our readers, when we have the good fortune to meet with it. But in connection with questions of jewelry, which do not concern us, we meet with several specimens whose object and means are quite within our jurisdiction, and respecting which we will say a few words.

In the notice which he has published on the subject of his exposition, M. Oudin-Charpentier announces that he has proved the superiority in the going of regulators *hung* to the wall over those whose support is the floor of the apartment. For very many years, and very probably even during the personal direction of the founder of Breguet's establishment, the regulators made in this house have always been arranged for *hanging* to the wall to assure them the greatest stability possible. We congratulate M. Oudin-Charpentier no less for having introduced into his manufacture a condition which, although ancient, had not seriously entered into general practice.

There is greater novelty in the idea of making a pendulum, shortened by nearly one-half beat the second, applied to suspended regulators, to accommodate them to the smallness of our modern apartments. However, this is not absolutely a novelty, for this pendulum already employed in Abraham Breguet's swinging clock is again that which Maelzel has applied to his metronome, the use of which is now so common, and which consists in placing, above the

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point of suspension, an additional mass whose weight, or the distance to this same point, regulates the duration of the oscillations.

But the pendulum of a regulator should be necessarily compensated; and as the means employed to compensate the portion placed below the point of suspension are quite without influence on the portion placed above, this kind of pendulum requires absolutely a double compensation very delicate to effect and consequently expensive. This last question, however, is secondary in cases where a regulator is necessary but where sufficient space cannot be obtained for an ordinary pendulum, or again, in the more numerous cases where art reigns in absolute sovereignty and subordinates the least discussable technical conditions to its more or less legitimate caprices. It is then in fact a real progress which M. Oudin-Charpentier has realised in rendering possible the accord of the two incompatibilities which we have just mentioned.

The sensation made in France by the adoption of a normal diapason has induced M. Oudin-Charpentier to place one in his watches specially destined for the use of professional musicians. That is the way to have it always within one's reach. But if this sensation has had some echo abroad, it is now much attenuated; for we have been unable to hear the faintest mention of it in the Palace at Kensington.

The horological instruments exhibited by MM. Desfontaines, Leroy and Son are of great exterior richness and are beautifully executed. We remark several kinds of visible escapements of an original arrangement whose object is the same as in a certain number of those which we have already mentioned; that of causing those instruments to mark the seconds, the pendulum of which beats only the half-second.

The marine chronometers exhibited by M. Vissiere, of Havre, offer nothing new in their arrangements. We have only then to mention them here to recall the reputation legitimately acquired by M. Vissiere, by the perfection of the instruments which he intends for navigators.

We are entirely wanting in information respecting the chronometers exhibited by M. Scharf de St Nicolas d' Alihermont. The same is the case with respect to the collective exhibition of Besançon.

The idea of applying dynamical electricity, as a motive force of apparati destined for the measurement of time is contemporary with that the object of which was the transmission by the same agent, of the human thought to distant places; and there are few persons, occupied by the electric telegraph, who have not thought about its chronometric application, either as a motor, or, above all, as a means of transmission to a distance time given by a regulator moved by any motor whatsoever. But, either from not being sufficiently familiar with electric phenomena, or from some other cause, the authors of the numerous attempts made with this double object in view were far from having attained it, when in 1853, M. Verité, of Beauvais, who is already known since 1844, by a regulator the pendulum of which is constantly independant of the motive force of the clock, and consequently of the variations of this force, not only as to the impulsion, but as to the disengagement of the wheelwork, succeeded with equal happiness, in substituting dynamical electricity for motive force, weight, or spring, which he had hitherto employed.

The action of electricity is limited in this arrangement to attracting successively, by two electro magnets placed to the right and left of the pendulum, a swing whose centre part is formed of a non-conducting substance and whose extremities are of soft iron. Each arm of this swing carries a little weight suspended from a very flexible metallic thread above a small bar forming a perpendicular with the top part of the pendulum. The circuit is established from the pendulum to the pile, and from the latter to the electro-magnets, by means of a bifurcation of the conjunctive thread, which is terminated, at its issue from the bobbin, by the much finer thread which suspends the two little weights below the swing.

Supposing the pendulum drawn from its vertical position until its contact with the little weight on the left; the circuit is formed, the current establishes itself, and the electro-magnet on the left attracts the left arm of the swing which causes the little weight on the left arm of the bar of the pendulum to sink, and gives to the latter the impulsion from left to right; an impulsion which is continued during the whole of the duration of the contact between the little ball and the bar of the pendulum. When this contact has ceased, the pendulum continues its movement by virtue of the velocity acquired, and the right arm of the bar comes into contact with the little ball on the right. The circuit is again formed, but the current passes into the electro magnet on the right, which attracting the right arm of the swing leaves to the little weight on the right all its action to give the impulsion from right to left, and so on until the electric source is ex-

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hausted, which, in the conditions established by M. Verité, may last six months and more without needing to be touched.

If we have been fortunate enough to make ourselves understood by our readers they will perceive that, whatever be the variations of the electric force, they are absolutely without influence on the rate of the pendulum, since however rapid may be the establishment of the current when the contact takes place between the pendulum and the little ball, the latter is slightly raised, by virtue of the velocity which the pendulum still retains, and that it is only when this velocity is completely annihilated by the resistance opposed to it by the little ball that the impulsion commences, so that this impulsion is constantly regulated by the unchanging height from which the little ball descends until the moment when the contact ceases. This instrument has therefore really a *constant force* in the strictest sense of the word.

At the exhibition of 1855, a clock by M. Froment, based on the same principle was exhibited. The only difference consisted in the employment of a single ball, giving the impulsion to the pendulum on one side only. In the exhibition of M. Détouche were seen also instruments by M. Robert Houdin, where the balls were replaced by springs raised by the action of the current, in order to act at the proper time on the pendulum, when the circuit was interrupted.

We have now to consider a new electric clock which also figures in the exhibition of M. Détouche. Although it works and ought to work according to the best arrangements, we regret to have to say that it lacks that character of simplicity which distinguishes so eminently its predecessors, and which in our opinion should constitute the fundamental condition in every electric clock. M. Détouche may, it is true, reply that all the mechanism being visible, the amateur would obviously give the preference to the more complicated instrument, which would attract the attention more, rather than to the modest simplicity of the arrangements before described. To that argument we have nothing to reply, and as all tastes exist in nature, we admit that in an industrial point of view those instruments would be manufactured in preference which please the greatest number. With this reserve, we have only praises to give to the arrangement adopted, the principle of which resides in the employment of a remontoir, performing the office of motive force on the pendulum, to restore to it the portion of velocity which it loses at each oscillation. This remontoir is formed of a satellite wheel engaging with another wheel, concentrically to the escapement wheel, upon which it is fixed, from which arrangement, by means of a click and spring, the satellite turns only one way round the other, that is to say when it is wound up. Becoming therefore joined with the escapement wheel, its weight tends to turn the latter, which is successively disengaged at each double oscillation of the pendulum, the movement of which forces back a check. A pin of the escapement wheel acts then on the single pallet of the demi-anchor to restore to the pendulum its lost velocity. The pendulum having the length suited to the half second, and the escapement wheel only being displaced once out of two oscillations, a hand fixed upon its axis, gives consequently the whole second. This is again an escapement called "á coup perdu." Every ten seconds, a piece belonging to the work of the satellite wheel, which has descended to its lowest point, acts upon another check, and maintains raised a straight copper spring. This spring when disengaged falls back on to the extremity of another straight spring, which forms the circuit and determines the attraction, by two electro-magnets, with a piece of soft iron, the movement of which produces the ascension of a vertical stem, armed with two projections. The upper one, placed below the satellite wheel, raises it by its axis, and winds it back to its starting point. The other, moveable on its axis and forming a kind of claw, raises the two springs, the contact of which forms the circuit and brings the upper spring into action with its check, then continues its rising motion beyond these same springs, which allows the lower spring to free itself from the first by virtue of its elasticity. The circuit is closed again, the attraction of the two electro-magnets ceases, and the vertical stem falls back by its own weight, without interruption in its descent, by the claw which turns on its axis when in contact with the two springs.

Such are the general conditions of the new electric clock, conditions which appear to us to attain completely the desired result. We think we may add, that in an industrial point of view, the forms and dimensions of the different organs employed reveal as much intelligence as sagacity. The other pieces of the very rich exhibition of M. Détouche containing only conditions long accepted in industrial practice, we need not consider here.

A few words respecting Perreaux' clock called *Sabliére*. This clock appears, in the eyes of most persons who see it work, rather a step backward than a progress, and leads

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us back towards the time when the hour-glass, the applications of which are so limited in the present day, was the sole indicator of the march of time. Without wishing to compare Perreaux' clock to an instrument of precision, we will say that it may give the measure of time to a remarkable degree of approximation, and at a very moderate price, because its mechanism is as simple as it is rustic, and is scarcely subject to derangement. Although the orifice through which the sand flows is regulated as to size to produce a determined flow of sand in a given time, it is the weight of this same sand acting as a motor, and not its volume, which gives the measure of time.

On the axis of the minute hand is fixed a rachet wheel. This same axis has a lever for its centre of movement and is maintained in a nearly horizontal position, as much by its counter-weight as by a catch which keeps it periodically bound with the rachet wheel. At the free extremity of this lever a trough is fixed into which the sand which is placed in an upper vessel, flows, and the flowing is suitably regulated. When the weight of the sand accumulated in the trough is sufficient to overcome the friction and inertia of the moveable pieces of this system, this lever being lowered, turns the rachet wheel, and with it, the hand indicating the minutes; the trough empties itself of the sand it contained, and the counter-weight of the lever raises the latter to its primitive height without turning the wheel in a contrary direction, because the catch yields in this retrograde movement, and places itself in the tooth next to the one it occupied before.

Let us not forget to mention that the descending movement of the lever has effected the closing of the orifice through which the sand flows, and that it is re-opened after the receiving trough has completely emptied itself of sand and is conveniently replaced under the orifice into which the sand passes. It is understood that by means of an ordinary dial the minute hand can drive the hour hand, and as to the striking, this is produced at the proper time by the automatical opening of a second orifice, through which the sand flows into successive troughs, the movement of which produces a blow of the hammer.

The dryness or humidity of the sand produced by the variable conditions of atmosphere appears to exert no influence on the going of the instrument. When moist, the sand flows less quickly through an orifice, but weighs heavier, and conversely; hence a double compensation would be effected.

When we have mentioned the springs of all kinds, exhibited by Montandon Brothers, of which the good qualities have been attested by all exhibitors to whom we have applied for information on the subject, we shall have completed the too succinct nomenclature of the products which have been offered for our study in the chronometric exhibition of France.

THE ASTRONOMER ROYAL'S REPORT.

Dated June, 1863.

The Astronomer Royal has sent us a copy of his report to the Board of Visitors, date June 6th, 1863. We are glad to learn from it that the contemplated railway through Greenwich Park has been altogether abandoned,—for such an undertaking we believe would be very prejudicial to the Observatory. Among the results of the past year's labour at the Observatory we read:—

"The meridional observations of Mars, in the autumn of 1862, have been compared with those made at the Observatory of Williamstown near Melbourne, Australia, and they give for mean solar parallax, the value 8″·932, exceeding the received value by about $\frac{1}{24}$ part."

"The mean magnetic declination for 1862 is about 20°52′; the diminution in the year appears to be 13′. The mean dip for 1862 is about 68°11′; at the present time it appears to be 68°4′."

Considerable labour has been given to a numerical discussion of the Magnetic Storms, from 1841 to 1857. The reductions are not quite finished; but they have suggested to Professor Airy, the idea, apparently confirmed by a separate deduction from the magnetic phenomena attending the splendid aurora seen December 14th, 1862, that, "the action of the earth-currents upon the magnet is in the same direction in which the earth-current flows, and not transverse to the current direction as is usual with galvanic currents." This result is certainly very remarkable. The Astronomer Royal adds:—"If this should be confirmed, then, viewing the rarity of disturbances in the vertical direction as produced by magnetic storms, and their great violence when they do occur in the vertical direction, I shall have no hesitation in suggesting, as a general theory of magnetic storms, that the idea of attrac-

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tion is to be abandoned, and that they are to be referred to currents of a magnetic ether whose movements are closely analogous to that of air, the vertical movement of which occurs but in few places, but in these places is excessively violent. Much, however, must be done, before such a theory can be established."

As regards chronometers and the communication of time, this is what the report states:

"The number of chronometers on hand at this time is 132; of these, 82 are compared with a standard clock every day, and the others are compared on one day in every week. The standard clock is one of a series of galvanic clocks whose movements are necessarily synchronous with that of the motor clock; which is accurately adjusted to mean solar time by means of a galvanic action upon its pendulum, that can be used for any arbitrary length of time to accelerate or retard the clock by slow degrees during that time. Every chronometer, whatever be the reason of its lodgment at the Royal Observatory, is tried during some part of its stay in the heated chronometer oven.

"When it is necessary to decide on the merits of chronometers, either as affecting their price for purchase, or as deciding their place in the published order of merit, the decision is made by me. The repairs of chronometers the property of the government are entirely managed by me.

"The drop of the time-signal-ball at Deal, by a galvanic current from this Observatory which is automatically given by the corrected motor clock, is perfectly efficient, no failures occurring except from the defects of adjustment of the clock at the London Bridge station which changes the connexions of wires. Time-signals are sent daily along the principal lines of railways, the most distant points (I believe) being Glasgow and Cardiff. I have also heard that the companies, through whose offices the wires pass, have begun to distribute branch signals to private factories.

"The clocks of the General Post Office are connected as formerly with the Observatory, each of four clocks being adjusted by current from our motor clock once every day, and reporting itself to us twice every day. The clock of Westminster Palace has also been brought into connexion, the attendant receiving a signal from us once every hour, and the clock reporting its state to us twice every day. As far as I have yet observed, the rate of this clock may be considered certain to much less than one second per week."

A NEW GRAVITY ESCAPEMENT, BY DR. CLARK, Hon. M.B.H.I.

The isochronism of the pendulum is a problem, the solution of which has long engaged the attention of horologists; and the highest powers of inventive genius to accomplish.

Hitherto, the application of the mechanical powers alone, have furnished the nearest practical approximation, for want of a more safe, constant, and uniform agency. The attraction of gravitation being the only reliable substitute for mechanical power, has equally failed, not for want of uniformity in its effect, but the uncertainty, or unreliable dependance on the mechanical arrangement to develope that system of impulsion. The attraction of gravitation then being assumed as the only reliable force, it is necessary to divest the impulsion as much as possible from mechanical influence, and throw the impelling power as much as practically possible on gravitation.

Up to the present time, the accomplishment of a more successful arrangement, so far as is known, has never so effectually been carried out, as in the Gravity Clock by Dr. Clark, No. 3233, Class 15 of the International Exhibition of 1862, where more than one hundred times the influence of any retarding force emanating from the irregularity of the train, is safely and securely cut off from the gravitating impulses acting on the pendulum. The accomplishment of this fact being brought below the natural disturbing forces, over which we have no control, will go further to establish the isochronism of the pendulum, and effect better results in chronometry, than any discovery antecedent to the clock now referred to.

All the parts essential to the escapement being shown in the engraving, the explanation presents little difficulty to be understood.

The present position of the escapement represents the left impulse pin D giving its impulse to the pendulum by the descent of the right gravitating weight E, which in the descent unlocks the left detent or stop F and at the time the acquired impulse is acting on the pendulum, the same time the arm H of the star or scape-wheel is unlocked and allows the arm I of the star or scape-wheel to repose on the right detent or stop F. The lifting pin B now throwing back the left lifting pallet C, allows the lifting pin A to free itself from the right lifting pallet C, which in its turn allows the impulse of the right pin D to act on the pendulum, through the descent of the left gravitating weight E and so on in succession.

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The arms of the star wheel must not be understood to act in a direct line, the alternate arms from H are set a little in, the other alternate arms from I a little out from the perpendicular, alternately resting on the detents or stops FF.

The advantages over the most popular gravity escapements in present use, as the Westminster and other clocks, similarly constructed, are the following,

1.—Requires no oil to the escapement, the detent pivots being oiled, merely as a protection from rust.

2.—The reduced friction in unlocking is less by one hundred times effected by the angle of detent planes and other advantages of the escapement.

3.—Unlocks without recoil of the impulse arms. The impulse and unlocking being effected in one direction only.

4.—No impeding force to the pendulum by the inertia of the impulse arms.

5.—The hold on the stops can be increased or diminished to any practical extent by reason of the inverted impulse arms.

6.—Less affected by any disturbing forces of the train, in proportion to the pressure on the detents or stops.

7.—Will bear more weight, and give more power to the train, without affecting the arc of oscillation.

8.—No possibility of tripping under any increase of motive power.

9.—The minimum arc of vibrations to unlock ·8 tenths of a degree. Other clocks of a similar construction require from 4 to 7 degrees.

10.—Takes less weight for the motive power in proportion to the difference of pressure and draught on the lockings.

11.—Unlocks by gravitation in place of the pendulum, and at the time of impulsion.

12.—Requiring no fly or remontoir, the reduction of weight or motive power is 50 per cent. less, and therefore the friction at the lockings is reduced in that ratio.

13.—The impulse giving motion to the pendulum, increases as the force of gravity on the pendulum decreases; a great advantage over unlocking where the momentum of the pendulum is nearly expended and at the extremity of its arc of oscillation.

14.—The angle of the detent planes can be set, so as to offer no resistance in unlocking, but on the other hand made to propel, the same as the impulse pallets of a dead escapement, completely freeing the impulse which gives motion to the pendulum from any retarding influence of the train.

15.—The arc of vibration more equal.

16.—Is not so liable to stop in consequence of a slight diminution of arc from the variation of motive force in the train as other gravity clocks.

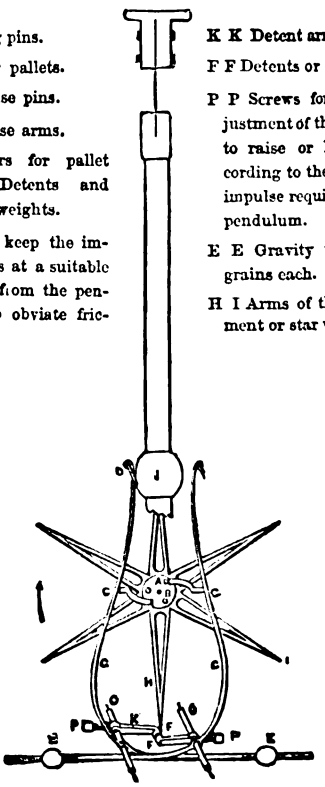
17.—By reason of the inverted impulse, the arms of the star, or scapewheel, can be so much longer in proportion to the radial distance of the lifting pins, exert very little pressure from the power of the train to unlock, being not more than $\frac{1}{12}$ of the force from the train; then 8 times the lever advantage for unlocking the detents, more than the force of impulse to give motion to the pendulum from the gravity weights, is $12 \times 8 = 96$ or a $\frac{1}{96}$ part less than the impulse required to sustain the motion of the pendulum.

18.—Will answer for regulators as well as Turret Clocks, arc of vibration from 1 to 3 degrees.

Proportions for astronomical clocks. The diameter of the star or scapewheel 3 inches. Impulse arms from the centres to the impulse pins DD, 3 inches. Detent arms or stops KK, $\frac{3}{8}$ of an inch. From the centre of the boss J to the suspension of the pendulum, $4\frac{1}{2}$ inches. The radial distance of the lifting pins $\frac{1}{8}$ of an inch.

A B Lifting pins.
C C Lifting pallets.
D D Impulse pins.
G G Impulse arms.
O O Arbors for pallet arms. Detents and gravity weights.
J Boss to keep the impulse pins at a suitable distance from the pendulum to obviate friction.

K K Detent arms.
F F Detents or stops.
P P Screws for the adjustment of the Detents to raise or lower according to the length of impulse required to the pendulum.
E E Gravity weights 5 grains each.
H I Arms of the escapement or star wheel.



[This interesting communication by Dr. Clark, came to us through Mr. S. Jackson, and we are indebted to Mr. J. F. Cole for the drawing. ED.]

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MAGNETISM OF PENDULUMS.

To the Editor of the Horological Journal.

Sir,—At a recent meeting of "The Literary and Philosophical Society of Manchester," Mr. Baxendell called attention to certain irregularities in the performances of certain clocks having mercurial pendulums of the "Graham" form, and which, although having well adjusted compensations for temperature and observed during a period in which no thermometric changes of any amount were noticeable, had to be accounted for without these as disturbing causes.

The coincidence of a rather brilliant aurora led to the idea of electric or magnetic causes, and on testing the stirrups of several mercurial pendulums, as might have been anticipated, they were found to be magnetic.

I have long suspected that the rates of pendulums were vitiated by terrestrial magnetism for the reasons following:—

Iron rods of every form are magnetised by induction if placed in the magnetic meridian, and are free only when at right angles to the meridian. They are affected by any approximation to the meridian in proportion to the degree and the purity of the metal; further, the vertical position is in all cases favourable to the appearance of polarity. Steel either soft or tempered, retains a portion of magnetism, when so circumstanced, and this magnetism connects it distinctly with every change that may occur in the magnetism of the earth.

As the earth's magnetism is known to be in a constant state of tremulous activity, a *swinging magnet* must have its time of vibration affected by this force, as directly as by that of gravitation.

In consequence of these views I suggested to Mr. Hartnup, as some alterations were about being made in the Liverpool Observatory (old Chronometer room), to try by comparison if any noticeable differences ever occurred in any two regulators having steel rod pendulums—one swinging in the magnetic meridian, the other swinging across it, stating at the time that I believed it might lead to the establishment of a new datum for horologists. The suggested experiment was however forgotten.

I think your pages might stimulate the enquiry, if the attention of Astronomers were drawn to the subject, especially where Meteorology is followed out minutely as at the Royal Observatory Greenwich, the Radcliff Observatory at Oxford, and the Liverpool Observatory.

Your's respectfully,
E. D. JOHNSON.

16*th June*, 1863.

In reference to this letter, we copy from the transaction of the Society, the following, from their minutes of April 7th, 1863:—

"Mr. G. C. Lowe exhibited part of a mercurial seconds pendulum, which, from its mode of construction, bears a strong resemblance to a horse-shoe magnet, and possesses considerable magnetic power. It is what is called the stirrup, and has attached to its lower extremities a circular brass disc, upon which the jar of mercury is placed. The stirrup is attached to the lower end of the pendulum rod, and has two steel rods, about ten inches in length, connected at their upper ends by a short steel bar, so that when magnetised the lower ends form one a north and the other a south pole. It had been suggested by Mr. Baxendell that some irregularities which are observed in the rates of clocks may be explained by referring them to variations in the intensity of the earth's magnetism influencing a pendulum which has thus become magnetised. He had noticed in two clocks which have mercurial pendulums sudden changes of rate amounting to nearly or in some instances quite one second per day. There were no considerable changes of temperature or of the atmospheric pressure at the time, and the compensation is so nearly perfect that so great a deviation from the rate could not be due to change of temperature. A very brilliant display of aurora borealis was observed by Mr. Baxendell on the evening when the last remarkable change of rate took place, which favours the view now suggested, viz., that the lower part of the pendulum having become magnetised, an increase or diminution of the intensity of the earth's magnetism may have the effect of accelerating or retarding the motion of the pendulum. Mr. Lowe suggested that if the rods forming the stirrup were connected with brass at the top instead of steel, they would have much less force as magnets. In a pendulum also under Mr. Baxendell's observation, the disturbance of rate was much smaller in amount, scarcely exceeding one-third of the change that was found in the two clocks already mentioned. This pendulum consists of a long steel rod and two shorter ones, and has a very correct compensation effected by a zinc tube. This pendulum has another advantage, viz., that the steel rods and the zinc tube are so nearly the same in size that sudden changes of temperature affect all the parts nearly simultaneously, whereas in the mercurial pendulum the steel rod is much more quickly affected than the large mass of mercury; the compensation therefore does not take place soon enough to prevent a small error in the clock's rate."

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METEOROLOGICAL OBSERVATIONS
Taken at 9 A.M., MAY, 1863.
Gray's Inn Road.

Days of the Month.	Barometer, at 32° F. and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	inches.	o	o	o	o				
1	30·292	45·5	42	52	34	E	4	bc	bc
2	30·184	49	45	57	38	NE	2	b	b
3	29 981	51	47·7	62	43	NNW	2	b	b
4	29·851	57	53	66	50	NW	3	cb	bc
5	29 841	57	53	66	50	WNW	3	cb	cb,p,cb
6	30·055	53	50	66	45	SSE	2	c	cb, o
7	30·135	56	53	65	49	NW	3	o	cb, b
8	30·404	51	47	65	41	E	3	b	b, o, bc
9	30·128	53	51	62	43	E	1	cb	cb, m
10	29 973	55	51	65	47	NNW	4	o	c
11	30·076	50	45	61	46	NW	3	c	o, qr
12	29·774	53	51	58	48	SW	7	r	r
13	29·668	54	51·5	55	51	W	4	c	c, pp, b
14	29·890	54	50	61	47	SW	3	c	o, r
15	29 827	57	54·5	61	52	SSW	4	or	r, mb
16	29·937	55	52	61	49	SSW	4	or	o
17	29·850	56	52	60	50	SSE	2	o	o, bc
18	29 900	56·5	53	60	46·5	NW	1	o	o, rr
19	29 940	44	42	62	43	ENE	8	r	rqq
20	30 063	46	45	48	43	NE	2	r	o, r
21	30·198	53	51	53	45	NNE	3	o	o, bc
22	30·100	49	46	58	41	E	3	o	o, c, b
23	29 896	50	46	55	39	E	3	bc	cb
24	29·920	49	46 5	60	42	NNW	2	bc	c, o, c
25	29·943	52	48 5	62	44	NNW	3	o	cb
26	30 174	51	46 5	58	41	NNW	3	c	o, bm
27	30·285	54	48·5	58	45	NNW	2	c	cb, bm
28	30 300	57·5	52	68	50	NW	3	bc	bc
29	30·263	57	54	72	53	NW	2	o	bc
30	30·210	64	60	77	57	NW	2	o	o
31	30·200	55	53	70	55	SE	3	r	o, bm
	30·041	53	49·7	61·5	46		3		Mean.

REMARKS.

The greatest barometric pressure was 30·41 inches, at 8 a.m., 8th; the lowest, 29·61, at 11 p.m., 12th; so that the greatest difference of pressure was 0·8 of an inch of mercury,

Rain fell on 11 days, during about 75 hours, to the amount of 1·31 inches.

The 9 a. m. observations show the wind to have blown from the N on 10 days; E, 8; W, 8; and from S on 5 days.

From the 5th to the 8th the wind veered from W, through N, E, S, W, to N and E again. From the morning of the 17th to midnight of the 18th, the wind veered from SE to S, W, N, E, to SE. On the early morning of the 12th the wind blew a gale from SW, and continued strong all day with rain. On the 19th a fresh gale from NE blew all day, with cold rainy weather. The local barometer gave no indication of this gale; but the low atmospheric pressure in France the day before, showed its approach.

The temperature of May has been 3° or 4° below the average, the rain-fall deficient, and the winds more northerly than usual, the barometer consequently ranging high.

Indications for July.

The length of the middle day at London is about 16 hours; the mean height of the barometer 29·97 inches, with a range of 0·7 inch; the mean *day* and *night* temperatures are respectively 73° and 53°; the prevalent winds are from W to N; and the rain-fall averages 2·7 inches on 16 days.

British Horological Institute
PRIZE FUND.

The project of a fund for prizes having been favorably received by the members of the British Horological Institute, it is desirable for the sake of a clear understanding as to what is proposed, to state the precise position of the matter.

It is intended to draw up a scheme, by which premiums either in money, medals, or certificates will be awarded to concise treatises on the more important departments of Horology, such as the Escapement, the Balance Spring, the Compensation for Temperature, the Movement, the subject of Guages &c. As the plan must depend for its extent on the amount of money available, the names of subscribers are to be taken first, and when an amount of, say £30, has been subscribed, it is proposed to call a meeting of the subscribers to ascertain their views, and to draw up the details of the plan. All questions as to subjects for awards, judges, method of publication of treatises, and in fact the whole details are to be decided by the subscribers, the Council of the Institute as a body, only taking the initiative and endeavouring to forward the plan to the utmost of their power.

In any case the money subscribed will be kept distinct from the funds of the Institute, and the plan will therefore have to bear its own charges for printing, advertising, &c. At the same time the pages of the Journal are open for information on the subject and any suggestions or correspondence may be forwarded for the present to the Honorary Secretary to the Institute, who will also receive the names of subscribers.

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THE BRITISH HOROLOGICAL INSTITUTE.

SPECIAL MEETING TO CONSIDER THE PROPRIETY OF REVISING THE INSTITUTE LAWS, &c.

On Friday, the 19th June, a Special Meeting, convened pursuant to a requisition presented for the above purpose, was held at the Institute Rooms. The Chair was taken by Mr. Vice-President Klaftenberger.

The Honorary Secretary read the following requisition, upon which the meeting had been called, in conformity with the 5th rule.

"To the Honorary Secretary of the British Horological Institute.

"35, Northampton-square.

"We, the undersigned, request you to call a Special Meeting of the members of the British Horological Institute within ten days from the date hereof, to take into consideration the present position of the Institute, and to appoint a Committee to consider and report to a Special General Meeting the best means of revising the laws, so that the Institute shall more fully represent the trade.

"London, *4th June*, 1863.

" R. Rodwell Hux	" L. Scheussler
Samuel A. Brooks	A. Rowlands
Edmund G. Lawrence	Robt. W. Goddard
John Wells	Samuel Holdsworth
Samuel Henry Hall	Thomas Hewitt
Hux & Sons	Henry Shanter
A. Ganard	J. Woodfall Howard
J. Morrison	Robert Hutton
F. Shick	T. F. E. Soller
Chas. March	John Lawson
Thomas Mercer	Charles Bacon
Thomas Benfield	WilliamHenryHarris
John A. R. White	Frederick Browning
George G. Barter	Henry Ganney
Ganevel & Callard	David Glasgow."
Kiessler & Neu	

Mr. J. R. Hux, in moving a resolution contended for the power of the members to call special meetings. Upon examination of the books it was found that during the last three years the Institute had made no progress in the increase of members, 161 only having joined it whilst an exactly equal number had left it. What was the cause of that stationary position? It was charged against those who had the management of the Institute, that they studied their own self-interest instead of the good of the trade. Again, there had been a violation of the laws of the Institute. A breach had been made with respect to clause 4 of rule iv. Many members had not been elected by a majority of the members present. There being a discrepancy of opinion as to the meaning of the rule it was time that its true construction should be determined. There ought to be open nominations and election by ballot. Suggestions for alterations of rules came very much better from the Council than from ordinary members, but during the last three years that body had taken no steps to make such alterations. Several members outside the Council might nominate the same person, and thus defeat their own object. Members of the Council who absented themselves from its meetings for three months successively should cease to be members of it. There were eleven gentlemen who had only attended its meetings twice from the time of the last general meeting up to the 18th of last May, and yet their names were published as members of the Council. Eleven or twelve of the nominal members of the Council had never attended its meetings, and there was one vacancy, so that only 15 out of the 28 members acted. The average attendance for five months amounted to 8 members. In the present nomination papers there were the names of five gentlemen for re-election, although they had never attended. The Council were aware of the fact. Another gentleman whose name was contained in it had declared that he was not a member of the Institute. At one meeting of the Council, one of its members exhibited an instrument which he intended to present to another gentleman; what had that to do with the business of the Institute?

Mr. Crisp and other gentlemen rose to order. Such personal allusions were improper.

Mr. Hux had been told when he was a a member of the Council by another member of it, that he would put something in his (Mr. H.'s) way; but he replied that he would not for a moment allow any man to be in a position to say that he had gained one farthing by his official position. The member replied that that was very honourable in him (Mr. H.) but other gentlemen were not so particular. As the Institute was a scientific society he objected to its being supported by charitable subscriptions collected after dinners. The Institute did not exist upon its merits, for without such voluntary contributions it would almost cease to be. Why was that? Because it had not the support of the trade. Committees should be

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appointed from the general body of the members, and they should report their proceedings to those members every month. He would move that a committee of five members be appointed to consider and report to a general meeting, the best means of revising the laws, so that the Institute might more fully represent the trade.

Mr. LAWRENCE seconded the motion.

Mr. JONES gave the mover of the resolution credit for being influenced by a desire to benefit the trade, but he had not indicated the best possible means of effecting the result he desired to attain. Every member had an opportunity of raising questions at the half-yearly meetings. In a few days the Council would be ready with a report upon the entire affairs of the Institute. The Institute had not done, and could not do, very much to advance the material prosperity of the trade; but there were substantial proofs round that room that the Institute had done a considerable amount of good for the trade. A little while ago he had been present at a meeting held to bring to bear measures for the improvement of the Institute, and the extension of its influence. During the early existence of such associations they had to encounter difficulties, but it was something to have got a plant and other means available for their purposes. Let Mr. Hux, instead of picking holes in the rules, co-operate with the Council in the good work. He (Mr. J.) could not regard the money given by wealthy gentlemen who honourably presided over their meetings in the light of charitable contributions; but as subscriptions for the promotion of science and art, in which the whole community were interested. With regard to the nominations there was no desire on the part of the Council to nominate members. The Council had selected certain names, but there was no impediment to members sending in others. The passing of the resolution would occasion great expense, and the effect would only be to anticipate by three or four days the general discussion at the half-yearly meeting. If it was found that the Council had not done its work properly, let the members find other men to do it better. For himself he was prepared to vote for Mr. Hux as a member of the Council, where he would no doubt receive every possible attention. They must not, however, disorganise the Institute, and therefore it was desirable to negative that gentleman's motion. No man had a right to expect that he should get so many pounds, shillings, and pence per week more by joining the Institute, but its objects were the general elevation of the horological art and the pleasure of gaining greater knowledge of the laws connected with that profession, and no doubt better payment in each department of it would ultimately be the result. Until they had a more learned body of persons on the Council, the members had hardly a right to complain that it had done no more than it had already achieved.

Mr. BROOKS at considerable length supported the motion. There were certain members of the Council who were as loud in their complaints of the neglect of their colleagues as the outside members were. More than two years ago, he had had the chance, both in men and money, of establishing another Institute; but he felt it right that the present one should have every chance of success before it was attempted to form another. There must be some alteration in the management of the Institute before it would have the confidence of the trade. If its members knew that there was a fair field and no favour for them in the Institute, it would not be wanting in funds. He had been told by a member of the Council, who had voted against a motion of his, that he approved of it, but he was not so well established in business as him (Mr. B.), and therefore, could not afford to give offence. The humbler stood no chance with the higher members of the trade at the board.—[The speaker was referring to a person near when he was called to order by the Chairman.]—The platform which the requisitionists offered was one upon which every member of the trade could act.

The CHAIRMAN denied that the members of the Council had been influenced by motives of self-interest. There would always be ill-feeling in the Institute as long as that jealousy existed, the cause of which he could never discover. Instead of canvassing and making mischief, why not send in fresh names for election on the Council.

Mr. BROOKS denied that there had been any personal canvassing; an errand boy had been sent round to gather the signatures, and not a word had been said to induce persons to sign the requisition.

Mr. HISLOP said that whilst there were a number of names of officers the work unfortunately fell upon a few. The plan of Mr. Hux would not answer his purpose. Members of the trade generally would not work upon the Council as the present body did and get no thanks for it. There was no objection to the fullest enquiry into the affairs of the Institute. The facts were arranged and could easily be got at by anybody. Upon three or four half-yearly meetings they had not enough members present

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to make valid alterations of laws, and he did not think that by the plan of Mr. Hux a larger number could be got together. A better conclusion would be arrived at by having the matter referred to the annual meeting. He was afraid that the plan of a Committee would not work well, but would rather widen than close the existing breach.

Mr. GLASGOW wanted to benefit the Institute. If the consideration of the subject was put off until the general meeting, it might be the same as at the last one, nothing would be done. It was the business of the Council to make meetings.

Mr. JACKSON was most decidedly opposed to the course proposed by Mr. Hux. He (Mr. J.) would move an amendment, calling on the Council about to be elected, to consider the amendment of the laws, and to report to a subsequent general meeting.

Mr. STRACHAN seconded the amendment.

Mr. GANNEY supported the resolution, and Mr. BLACKIE the amendment.

Mr. HUX replied.

A show of hands was taken, and there appeared for the amendment, 15; against it, 12.

The resolution was then carried as a substantive motion by 16 for, and none against it.

A vote of thanks having been passed to the Chairman, the proceedings terminated.

HALF-YEARLY MEETING OF THE MEMBERS.

On the 24th June, a Meeting was held pursuant to Rule V., to receive a Report of the State and Proceedings of the Institute, and the Balance Sheet shewing its Financial position, and to Elect a Council and Officers for the Year ensuing.

Mr. VICE-PRESIDENT JOHN JONES, F.R.G.S. occupied the Chair.

MODE OF CONFIRMATION OF MINUTES.

The Minutes of the last Half-yearly General Meeting and the recent Special Meeting were read by the Honorary Secretary, Mr. Hislop, and were now to be submitted for confirmation.

Mr. HUX, Jun., objected. He had attended the meetings on several occasions, and he believed that the present was the first occasion on which such a course of proceeding had been adopted. The usual course was for the Council to confirm the minutes of general meetings.

Mr. HISLOP was of opinion that the Council had not legal power to express approval or disapproval of the proceedings of the meetings of the members, who alone had the right to say whether they were or were not correct.

Mr. HUX objected to that portion of the minutes which referred to the mode of election of honorary members, which, as he had stated at the previous special meeting, was irregular.

The CHAIRMAN regarded the vote merely as an expression of the members, as to whether the proceedings were or were not correctly entered.

Mr. HISLOP explained that the vote then before the meeting was no confirmation of proceedings at all, but simply of the correctness of the entry of the minutes.

Mr. HUX with that construction would not object.

The minutes were then read and unanimously approved.

The HONORARY SECRETARY then read the Report and Financial Statement.

The CHAIRMAN:—Gentlemen, it is now my duty to propose that the Report be accepted by the meeting, as a satisfactory answer by the Council to the question as to how their duties have been performed during the past half-year. I look forward to the Institute providing for watch makers a position in society such as the multifarious ingenuity displayed in all parts of the trade justify it in claiming. When we look at the productions of any one branch of the horological art, and regard it as constituting in itself a trade, and see that the men who wholly devote themselves to that branch stand well with the world; and when we reflect upon the fact, that the production of the entire instrument for time-keeping comprises numerous separate parts, every one of which constitutes a distinct art—when we take this view of the matter, watch making seems to me to be no longer a trade, but to rise to the dignity of a profession. The range of knowledge, the many contrivances, the long period of labour and instruction necessary to be passed through before a man becomes a master of the craft, justify us who belong to this art in demanding a better social position for its professors than they have of late years held. Why then are instances daily occuring in the little manipulations of manufacture connected with the watch which pass without any comment, but which when used separately elsewhere create for a man high renown. I might, for instance, notice what is called the Brunel operation in medicine, which gained for the great railway engineer quite a name. A child had got a sixpence, in its throat and the medical profession were unable to extract it, Mr. Brunel suggested that the little one should be turned upside down, when there would be every probability of its falling out. The experiment was tried with success. The faculty were startled at the boldness of the idea, and the experiment is now traditionally spoken of as "The Brunel invention" or "discovery." But no watchmaker who let a verge fall and got it back by turning the instrument upside down would

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fancy that he was doing an act worth naming. I merely mention this circumstance as illustrating the fact that there are involved in our manufacture many ingenious contrivances for producing certain ends besides the ends themselves. Take for instance, the case of the reflector, which you use if you want to look into a jewel hole. There was a long discourse pronounced in a learned society occasioned by the fact that a medical man had contrived a reflector which would enable surgeons to look into the cavities of the human body, and great compliments and a prize were awarded to the so-called inventor; but watch makers would feel that they were not entitled to any praise for such an alleged discovery as that. Yet we watch makers are made the repository of multitudes of clever contrivances, which have been accumulated by the ingenious resources of the members of the different branches of our art, each one of which would, upon the principle I have before referred to, be sufficient to enable a man to become celebrated out of doors. Those who are daily engaged in the ingenious operations connected with watch making do not take that position in society which their intellectual attainments justify them in obtaining. I think, therefore, that you will recognize it as a very pleasing fact that the Council has put forward a suggestion that the Institute should endeavour to gain for itself something like a corporate existence, which may enable the public mind to recognize its importance. If you thus establish any where a central authority, which more or less regulates the operations of the trade, you give to the members an advanced position in society at large resulting from that combination. Of late years we have too much lost sight of the old guild principle, which once existed in this Metropolis and elsewhere. Such combinations in trade are the means of bringing out the intellectual faculties more actively, and are the great secret of trade elevations. Then again I also think that they tend to purify the trade from unfair usages. I think that a central authority, without any legal power, would be a check upon those who are disposed to trespass over the fair boundary line of trade. It would be very easy for the Council, whenever it might become necessary, to indicate that such and such acts are unworthy of members of the Horological Institute. With reference to the special advancement of the art, if we assemble here merely to read accounts of money, and to talk of something that is to be done for the benefit of the art itself, nothing really substantial is thereby effected for its benefit. But the action which the Council has taken seems to promise some positive good. The plan proposed, it seems to me, will elicit the intellect of the trade in all its various channels. A proposition has been made at Coventry for the payment of so much money as prizes for certain productions. Upon reading it I came to the conclusion that the plan has not emanated from a watch maker, but from some benevolent individual not connected with the business; for the work proposed to be done in proportion to the payment suggested to be made for it is enormous, and for all practical purposes I do not think that such a scheme is likely to be of the least service. But that suggested in the report read to-day I think must be admitted to be at least something in the right direction. I think that the watch makers present will recognize in it, when it comes before them in detail, a project which is capable of being worked out with great success. As far as my own opinion goes such will be the case. I do not know what will be the final result; as has already been indicated that will be left to the decision of a subsequent meeting of the subscribers when the funds have reached a sufficient amount. Those subscribers will have a voice in determining who shall be the examiners, if there are to be any appointed, and how the funds are to be applied. The Council are not desirous of forestalling any one; or to have any special authority in the management of that fund. But supposing that the subscribers see fit to give the management into the hands of the Council, I would say that they should not feel at all isolated in the matter. What our aim is, as well as that of the subscribers, is to elicit an advance of knowledge in the horological art, as well as to diffuse more extensively the horological knowledge which already exists. One means for carrying out the latter object will be the Horological Journal, and another the exhibition in this room of the museum. A third will be the conversational meetings. The object will be to urge men to advance into a higher department of knowledge. We must endeavour to induce those who possess knowledge to impart it to others; to urge the great intellects of the trade to apply their minds to some special subject, in the hope that they may be enabled to accomplish a particular result through the incentive of the prizes and honours which the Institute will be able to confer. I think that it is quite possible that with reference to many subjects of interest and importance to the trade, there are floating in the minds of its members many ideas which their daily duties and the regular demands of their business forbid their losing their time in bringing to practical perfection, but which they promise themselves, at some convenient season, to endeavour to work out by experiment, and unless some pressure is applied to them that convenient season will be put off until very likely they have made their fortunes and have left the trade, or some accident has occurred which has obliterated all their knowledge. That there are many men who have this inventive genius, who, may find a sufficient encouragement for offering their discoveries to the society, even although the amount may not be very large, yet the prize will carry with it both money and honour, and that slight impulse may cause them to give up for the general benefit of the trade some portion of that time which otherwise would have been devoted to their ordinary pursuits. Not only will they win honour for themselves, and cause others to become recipients of benefits they have created,

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but they will enjoy the satisfaction which arises from the discovery of knowledge. I believe that this is all I need to say in justification of what the Council has done. It is not for me to speculate upon what may be done when the subscribers will meet to confer upon the best mode of carrying the design into effect. I presume that each particular department, or speciality of the trade should be named, according to some rule or judgment, for each of which a special paper should be supplied. The financial statement which has been read, as well as the report, I trust has been satisfactory to you. I should be pleased if the Institute was able to give such entertainments, as the Society of Civil Engineers do. I should be glad if we were able to take this or some larger room, in which to have a collection of interesting objects connected with the horological art lent for the occasion by different members of the trade, who might be then assembled at what in fashionable phraseology is called a "soiree." That would be a pleasing way of winding up the season, because it would be very interesting, and would enable us to know practically what was being done in the highest departments of our art. I think that the International Exhibition did some good for British horologists by stimulating men to bring their thoughts down to a practical purpose. If the trade support the Institute we may look forward to a time of far greater usefulness than it has ever had. With these remarks I move that the report which has been read be accepted by the meeting.

Mr. KLAFTENBERGER seconded the motion.

Mr. BROOKS said that he was not about to object to the report, but he still thought that the present was a proper time to urge a few considerations upon the meeting as to the mode of government of the Institute. All its well-wishers must rejoice when they heard that it was going on well. They must feel particularly obliged to those who had carried out its management, as far as pecuniary matters were concerned, by keeping down the expenses. The Honorary Secretary had achieved a great reduction in the expenditure. At the same time whilst rejoicing in that success, it appeared that opportunities had been missed which the Council might have availed itself of. They had done wrong in going on for so many months with so few to assist them in their labours. He objected to their screening the faults of those who had been thus negligent, because it was not only unfair to themselves, but also to the absentees. It was a kindness to such an habitual absentee to remind him that he had undertaken certain duties, for which he was receiving a certain amount of honour, and that therefore he ought to perform his engagement. Then it was said that the difficulty of getting members of the Institute to work was so great that the Council were obliged to keep matters as they were. He (Mr. B.) objected to that statement. There were plenty of members who would be glad to assist the Council. Then again it was said that members had the privilege of nominating candidates for the Council, but would not avail themselves of it. He denied that the members practically had that opportunity. It was the duty of the Council to have selected such a number of candidates as they thought would be serviceable to the Institute. Had the Council been really composed of twenty-eight members instead of only eight, what different results might have been achieved. No one could say that as a rule those men had been elected upon the Council who had most endeavoured to develope the art of horology and to be most useful to the Institute. He was quite sure that he spoke the private sentiments of every member of the Institute who worked hardest for it, when he said that those who took on themselves its honours had not performed the duties of their offices. Much of the honour of the origination of the scheme of prizes was due to the conversational meetings. If the Council could be brought together more frequently something better would be achieved by it than had been effected hitherto. He hoped that they would see the mistakes they had made in the past and endeavour to remedy them in the future.

Mr. JACKSON, as a member of the Council, wished to make a few remarks in reply to Mr. Brooks. Every member of the Council was quite willing to echo Mr. Brooks's desire that every officer of the Institute should do his duty; but so difficult had they found that object to carry out, that there was before the meeting that night a proposition to reduce the number of the members of the Council from twenty-eight to twenty; to what was deemed a working number, or something approaching to it. It was an unfortunate fact that in every society there was a certain proportion who alone did the work. In their own case it certainly was a minority. Whilst agreeing with Mr. Brooks that every member of its Council should determine not to be a sinecurist, yet he was afraid that it was hardly possible to attain to that state of things. But he (Mr. J.) wished to point out emphatically an erroneous statement which Mr. Brooks and Mr. Hux had made at a previous meeting, respecting the alleged closeness of nomination of the members of the Council. On the part of that body he could declare that there was nothing approaching to closeness. Their Honorary Secretary had informed the members, that it was competent for them to nominate candidates for the Council, if they pleased, and that was done in ample time for any one to have availed himself of the notification. That public intimations removed any ground of complaint that members were ignorant of their right to do so, but the fact was that they did not feel sufficient interest to induce them to read the notice; for the election took place without a single nomination made outside the Council. He would, therefore, emphatically ask whether the fault did not lie with the members of the Institute? Those who objected to the scanty proceedings of the Council did infinitely less, for they did nothing at all. In order to prove that he was not speaking without a warrant he

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would take the liberty of reading two paragraphs as an answer to what was said with regard to what had been designated close nominations. In no case, as far as his knowledge went, had there been any hesitation on the part of the Council in accepting the nomination of any candidate made outside its own body. In rule viii. it was provided :—

" 1. All votes for officers to be by ballot.

2. Each member shall be entitled to nominate in writing to the Secretary persons to fill the above offices ; such nomination to be made at least fourteen days before the day of election."

After that the statement about closeness of nomination required no further observation to refute it. The gentlemen who made the complaint would not themselves take any trouble to nominate other candidates, and, therefore, it was very unfair in them to come forward and make complaints that the Council had not done its duty. He hoped that any remarks made upon that subject in future would be substantiated by something more than mere general statements, and be accompanied by facts which they could at all events handle and reply to.

Mr. BLACKIE could confirm the statements of Mr. Jackson. On the occasion when the list was made up the general business of the Council was done an hour before they closed the list of candidates. They sat until ten o'clock for the express purpose of seeing if any of the members would take the trouble of sending in names of candidates. At a few minutes past that hour they had not received one. Why, then, should several persons find fault with the Council which had desired and displayed nothing but openness in all its transactions ? Ever since he was connected with the Council he had been at its meetings and had attended assiduously to the books and other business to the utmost of his power ; yet himself and others were found fault with. It was very easy for gentlemen to point at the black side of things without looking at their sunny aspect, Those who found fault never took the trouble to look at the right side of things. He hoped that after that night's meeting it would go forth to the trade generally that the charges brought against the Council were wholly untrue.

Mr. GLASGOW said that there was no desire on the part of the Council to exclude those outside its body from membership of it. He believed that that was so, because they had no such power of exclusion ; but how was it that members of such a scientific institute felt so little interest in it that they would not take the trouble to belong to its Council ? He believed that that disinclination was owing to distinctions made concerning social position. He had never found existing any where such tyrannical conduct towards those beneath them in the same trade as was practised amongst watch makers. He was much obliged to the Council for having nominated him a member of its body. He would, however, very much sooner have been elected by the members of the Institute at large, but rather than be a dog in the manger he would accept the election as it was.

The CHAIRMAN :—The election must be by the members.

Mr. GLASGOW contended that as there would be no election on the present occasion, he could not be " elected " in the proper sense of the word. He hoped that the members of the watch trade would take to heart the statement of the Chairman that they ought to be in a more respectable social position. The Institute ought to be the means of elevating instead of depressing the members of the trade.

Mr. KLAFTENBERGER said that observations had been made by various gentlemen concerning the proceedings of the Council. Since he had been a member of that body it had done everything in its power to forward the interests of the Institute ; let them carry their minds back to the time when the lectures were delivered ; what did the Council do? it went to the expence of hiring a large room for the accommodation of the members of the trade, but so little interest did they feel in those lectures, that the Council was obliged to give up the plan and return to the Institute Room. Their Honorary Secretary took the trouble to get up a course of ten most valuable lectures, but few attended to hear them. Was not such apathy heart-breaking to that gentleman ? For his own part he had joined the Institute for the very purpose of becoming acquainted with men as well as with masters. Through the Institute he had become acquainted with many good men whom he never should otherwise have known. Great benefit arose in that respect from their associating together ; for example, the question was sometimes asked "who is that gentleman?" and the reply was, "He is an escapement maker, and a very beautiful workman he is." By that means they became acquainted with each other for their mutual benefit. There were men in the trade who were admirable workmen, but whose qualifications were only known to one or two persons. If every workman and master connected with the trade would take the same view as he had taken upon the subject the Institute would certainly flourish.

Mr. HUX said that a glowing picture of the future had been drawn, and had the past been as pleasant as that representation he should have been very well satisfied with it. There was one part of the report to which he took exception. It was that which contrasted the present favourable position of the finances with the bad state in which they were formerly.

THE HONORARY SECRETARY explained that the portion of the report Mr. Hux alluded to was the following:—"Your Council have first to remark an improvement in the finances and prospects of the Institute. A rigid adherence to economy has enabled them to recover ground lost in the early period of the Institute's history."

Mr. HUX denied that that statement was strictly true. He had the honour during the second year of its existence of being Treasurer of the Institute, and when he left office he handed over a balance of £86, which sum was sufficient to pay off all its then existing liabilities. With regard to the system of nominations he

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asked the Council why they nominated over and over again gentlemen who never entered the Institute or took any active part in its affairs? The members had not the best means of knowing who were doing their duty and who were not, but the members of the Council had, and they certainly had made a very poor case in their defence, because although they were compelled to admit that those members did not attend, yet they persisted in nominating them again for re-election. In the face of that fact there were gentlemen who stood up and said, that the nominations were open and free for everybody. They were told that members might nominate candidates if they liked to do so; but they were not in a position to do so. They did not know who were members and who were not. He wished the Institute success. He believed that the plan referred to by the Chairman, of giving prizes would, if carried out, prove beneficial to the Institute.

Mr. Hislop asserted that the Institute had not got into debt during the last two years. What Mr. Hux said was perfectly true as to the financial condition of the Institute when he resigned his Treasurership. But since then they had not been going backwards but forwards in their financial position. With respect to the conversational meetings he personally had done all he could to promote their success. He had been told of some suggestions made at those meetings which he had laid before the Council. The idea of the prize fund arose from the Coventry Watchmakers' Association, the circular of which stated that certain prizes were to be offered for certain objects; and he brought the matter before the Council. It struck him that their mode of doing it was a mistake altogether. He thought that the Institute was not in a position to work out the plan itself from its ordinary funds but that it should be carried into effect entirely by a separate subscription. The members of the Council present agreed with him in opinion. They called a special meeting at which was sketched out the present plan. Some gentlemen put their names down as subscribers to the proposed prize fund. They had not asked a single person, and yet they had £17 subscribed as a nucleus for the purpose. Perhaps the meeting would allow him to read a note which he had penned for insertion in the Journal embodying the views of the Council upon the subject*. In his opinion no part of the proceedings of the Institute since its formation was more important than the establishment of this prize fund, which would be of great use to the trade generally. In England they were behind foreigners in the possession of good horological literature. They had no books to put into the hands of apprentices; nothing for either man or master to study. If they could succeed in getting competent persons to put their thoughts together by paying them the value of their labour, at the same time that such persons made themselves a name, they would have done something for the trade.

There was another point to which he would refer, he had asked the finance committee to draw up a statement of the money owing by the Institute, on the morrow, June 25th; comprising rent, taxes, and everything else, and any possible claim which might be made upon it, and on the other hand a statement of the amount owing to it for advertisements, subscriptions, or other sources, including of course the subscriptions which would be due on the following day, and the result was, that after deducting all doubtful debts and looking at their position in a fair light, that they were something like £55 on the right side of the account, there would be about £75 due on the morrow for subscriptions. In addition to what was included in that statement there were valuable assets in the shape of back numbers of the Journal, the valuable articles in the museum, furniture and other things. That satisfactory position was a fair subject for congratulation, because it proved that they were quite warranted in asserting that they were out of debt. He did not think that the trade had properly taken up the objects of the Institute, in consequence of motives of unfounded jealousy existing among themselves. Those who joined heart and hand with such a society as the Institute, were benefitting themselves by increasing their own knowledge. At the present time the Institute had something like 320 members, a good germ for its future prosperity, and if the members would but kindly co-operate with the Council it would get on rapidly, he was happy to find that an earnest desire for its success was a prevalent feeling with all the gentlemen present. If all the members would help the work would soon be done; but the most difficult part of the whole was to get their co-operation in any thing. Gentlemen fancied that joining the Council or becoming an officer meant hard work, which it did to some extent; but if there were a number of hands to divide it among, it would no longer become irksome, but be thoroughly pleasurable.

Mr. Marriott felt very much encouraged and gratified by the report, and he hoped that the Council might now be able to lead the Institute on to a higher pitch of prosperity than ever it had attained before. He had not been privileged to attend the conversational meetings, but he felt sure that if they were properly taken up by the trade they would be the means of bringing out much inventive genius. The foreign watch makers might supersede the English horologists if they did not take more interest in the trade than they had done. Statements had been made that the Council took upon itself to govern the Institute, without inviting the members of the trade generally to take part in its management; but from what had been stated that evening it really was quite evident that the members did not generally appreciate the value and importance of such an association. Were all to put their energy, skill, and intellect to work, the Institute would progress as it should do.

* See Horological Journal, No. 50, p. 130.

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The CHAIRMAN did not know that it was necessary for him to make any comment in defence of the report in reply to any thing which had been said about it. Periodical meetings were excellent opportunities for men to say what they thought. By trade associations between master and man as much benefit was gained on the one side as on the other. When they knew a man they had the better opportunity of judging of his character and qualifications, than they had had before. Occasional meetings like that gave opportunities for acquiring that knowledge, and so far the Institute tended to remove one of those objectionable features that previously characterised the members of the watchmaking trade.

The resolution was then put, and agreed to, *nem. con.*

EXPRESSIONS OF SYMPATHY WITH THE INSTITUTE.

The Honorary Secretary read a note from the Coventry Watchmakers' Association, and another from a similar association at Edinburgh, expressing their good wishes for the prosperity of the Institute.

IRREGULARITY IN FILLING UP BALLOTING PAPERS.

The Chairman announced that a considerable number of the balloting papers had been rendered invalid in consequence of the neglect of the members to sign their names upon the envelopes, as required by one of the rules.

RESIGNATION OF MR. J. F. COLE.

MR. BROOKS enquired if all the gentlemen whose names were on the balloting paper were willing to serve if elected.

The HONORARY SECRETARY replied that he had received a communication from Mr. Cole requesting his name to be withdrawn from the list; but the letter came too late to allow of the wish being complied with. He (Mr. H.) had not the letter with him.

Mr. BROOKS said that Mr. Cole had told him that he would not serve office nor set his foot in the Institute. Although that determination was known that gentleman's name had been removed from the list of Vice-Presidents, and placed in that of the Council. If he (Mr. B.) was correctly informed the letter was sent in sufficient time to have enabled the Honorary Secretary to have scratched out the name from the list.

The HON. SEC. :—Certainly not.

Mr. BROOKS had only seen Mr. Cole once; but the fact bore out all that was said at the Special Meeting as to the mode of management of the Institute. It was not quite consistent with fair dealing that that letter should be kept back from the meeting.

The HON. SEC. :—You shall see it, for I have just found it.

ELECTION OF COUNCIL AND OFFICERS.

The CHAIRMAN interposed. The letter of Mr. Cole could not affect the business then before the meeting which was the election of a Council and Officers, respecting which it only remained for him to announce what had been the will of the members. After that the question of Mr. Brooks would be pertinent.

Mr. BROOKS proposed an adjournment of the election in order that there might be a proper election. More than one or two gentlemen in the list of Councilmen now about to be declared elected had not only declined to serve upon the Council, but even to subscribe to the Institute. (Cries of "Name.") They must allow him to use his own discretion about naming them. ("No, no.") If his word was doubted he would tell the Chairman in confidence who they were. ("No, no.") The members were called upon to elect 28 members, and there were only that number of candidates.

The CHAIRMAN replied that the meeting had met for the purpose of electing a Council and Officers, the time and mode for doing which was fixed by the rules, and he had no power to adjourn it. Nothing now remained but to announce the names of the gentlemen elected.

Mr. BROOKS replied that whilst there was a duty in the chair there was also a right of discretion in the members. The members did not get a fair opportunity of being heard. According to the dictum laid down, however wrong the election might be, there was no power of remedying it.

The CHAIRMAN felt it his duty to interrupt the speaker.

Mr. BROOKS :—If you decide that I have not a voice here I will set down.

The CHAIRMAN said that he adjudged to the best of his knowledge in the matter. If the Institute had a solicitor, he would have been present, and might have been referred to. If it was competent to the meeting to adjourn at all they might do so for six or twelve months, or even for any indefinite time, say six years, during which time the Institute would have lapsed for want of officers. If a solicitor had been present and decided that according to the laws it was competent for him as Chairman to receive such a motion of adjournment he should have yielded to his opinion at whatever risk to the Institution. He believed that it would be quite wrong for him to allow such a course to be pursued. Authority to decide such a question must lay with him as Chairman. He thought that it was a little harsh on the part of Mr. Brooks to say that the present proceeding was another evidence of the despotic interference of the Council with the action of the members. He (the Chairman) was there to do what was right to the best of his judgment, and he should be deserting the interests of the Institute if he allowed what he believed to be the fatal error to take place of adjourning the adjudication when they had no legal power to re-open the question. On that very day the election of the Sheriffs of London had taken place, and the Town Clerk had told him (the Chairman) that the City charter would be lost if those functionaries were not elected on that 24th of June. He took that as a parallel case to the present, and therefore in the best use of his judgment he now declared the following gentlemen to be elected :

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President:

VALENTINE KNIGHT, Esq., 3, Cornwall-terrace, Regent's Park.

Vice-Presidents:

C. J. KLAFTENBERGER, Esq., 157, Regent's-street.
JOHN JONES, Esq., F.R.G.S., 338, Strand.
E. D. JOHNSON, Esq., F.R.A.S., 9, Wilmington-square, Clerkenwell.

Council:

CALLARD, W., 27, Alfred-street, City-road.
CRISP, W. B., 82, Saint John-street-road.
GORDON, THEO., 26, Great James-street, Bedford-row.
GLASGOW, D., 23, Myddelton-square.
GANNEY, HY., 72, Ossulton-street, St. Pancras.
HOLDSTOCK, T. W., 25, Percival-street.
HOLDSWORTH, S., 50, Spencer-street.
HEWITT, T., 11, Green-terrace, Upper Gloucester-street.
HOWARD, R., 29, King-square.
JACKSON, S., 66, Red Lion-street.
KNIGHT, F. W., 8, Upper Smith-street.
KULLBERG, V., 12, Cloudesley-terrace, Liverpool-road.
MYLNE, G. E., 22, Great Percy-street.
MORTON, GEO., 31, Hanover-street, Islington.
MERCER, THOS, 45, Spencer-street.
MACLENNAN, 6, Park-place, Highbury-vale.
ORAM, GEO., 19, Wilmington-square.
RICHARDS, H., 2, Butler's-place, Penton-street.
STORER, E., 49, Spencer-street.
STRACHAN, R., 7, Arthur-street, Gray's Inn-road.
STEVENS, MARK, 31, Myddelton-street.
TILLING, J. L., 1, Elizabeth-terrace, Liverpool-road.
TREWINNARD, J., 40, Providence-row, Park-road.
WARMAN, F. R., 49, Spencer-street.
WALSH, A. P., 46, Wilmington-square.
WEBB, HENRY G., 159, St. John-street-road.
WHITE, J. A. R., 9, Green-terrace, Clerkenwell.

Treasurer:

G. BLACKIE, Esq., 24, Amwell-street.

Honorary Secretary, (pro tem.)

W. HISLOP, Esq., F.R.A.S., 108, Saint John-street-road.

The CHAIRMAN expressed a hope that the words in parenthesis following Mr. Hislop's name would really be "*Pro tempore longem*," or "For a long time." (Hear.)

FURTHER EXPLANATION CONCERNING MR. J. F. COLE'S RESIGNATION.

Mr. HISLOP explained that he had written to Mr. Cole in reply to the letter of that gentleman, to inform him that the list of candidates was in type, and that he as Honorary Secretary had no right to withdraw a name from it after it had been approved of by the Council.

Mr. JACKSON said that as the retirement of their much esteemed and valuable friend Mr. Cole had occasioned a vacancy in the Council let those who complained of secret nominations come forward and fill it. Let them assist, and not merely bring complaints against others. An opportunity was afforded for either Mr. Hux or Mr. Brooks to become an active member of the Council.

The CHAIRMAN observed that it was a matter over which the Council really had no power.

Mr. GLASGOW thought that it was not a compliment to Mr. J. F. COLE, who really was the greatest man in the trade, to remove his name from the list of Vice-Presidents and to place it on the list of the Council. It was a matter of bad taste and he (Mr. G.) was sorry such a thing had occurred.

Mr. KLAFTENBERGER said that there was no man whom he more respected than Mr. Cole, whom he had known before he (Mr. K.) could speak a word of English. Although a good natured man, however, he had his peculiarity of temperament. An endeavour was made to keep him on the Council because his name was an ornament to it.

The HON. SECRETARY said that he had wished Mr. Cole's name to be struck out of the list, as he did not attend, but Mr. Johnson persisted in nominating him. The nomination was not that of a majority of the Council but of a single member. The only reason for not nominating him again for Vice-President was because he had previously not done his duty in that position.

ELECTION OF AUDITORS.

Messrs. BROOKS, BROWNING, and HEWARD, were duly proposed, seconded, and elected to be auditors.

REDUCTION OF THE NUMBER OF MEMBERS OF THE COUNCIL.

The HON. SECRETARY announced that in consequence of there not being the minimum number of members present, namely 30, necessary to authorize an alteration of rules, there must be a postponement of the following notice of motion by Mr. Blackie:—"That the number of the members of Council be twenty, instead of twenty-eight."

PROCEEDINGS OF THE COUNCIL.—ASSISTANCE RENDERED BY MEMBERS OF THE COUNCIL TO THE INSTITUTE.

Mr. BROOKS said that he had been charged with finding fault with the Council for doing so little, and at the same time did not render assistance to the Institute himself. As far as Mr. Hux and himself could they had rendered it assistance, especially during the past six months. He had been present at all the conversational meetings but one. Having frequently solicited persons to become members of the Institute he had unfortunately thereby become acquainted with the prevalent feeling against its management that existed in the trade. He would never submit to come upon that or any other Council to be voted down and misrepresented, as he had been when he belonged to it.

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Mr. Hux in reply to Mr. Jackson maintained that he had always studied the interest of the Institute. He had refused to act on the Council because he did not choose to come there to be swamped by votes, and yet be held answerable before the trade when things went wrong. One gentleman was told that he was nominated on the Council only that he might be made a handle of. What was the meaning of that? Simply that they might disgust him and induce him to withdraw his name. (Loud cries of "Name, name.") I will not.

The Chairman:—This proceeding is very irregular.

Mr. Hux:—I have certified that the minutes of a certain meeting were right; and yet a gentleman asked me to alter them.

The Hon. Secretary:—When?

Mr. Hux:—Two years and a half ago. ("Oh.")

A Member:—It is really shocking to hear charges now made against persons for transactions which occurred so long ago.

Mr. Klaftenberger:—Because a Member of Parliament had been transported, was a slur to be thrown upon the whole of the House of Commons?

The Chairman:—Unless the gentleman has got something more than personalities to advance I must decline waiting in this chair any longer.

Mr. Jackson said Mr. Hux had proved that he desired to promote the prosperity of the Institute.

Votes of Thanks.

Officers and Council.—Mr. Ganney proposed a vote of thanks to those gentlemen who had attended and done their duty during the past year; which being duly seconded was carried *nem. con.*

The Chairman returned thanks on behalf of the Council.

The Honorary Secretary.—The Chairman suggested that a special vote of thanks should be given to Mr. Hislop for his general services, and particularly for the course of lectures he had delivered at the Institute, which were so appreciated by the government that they were anxious to participate in the privilege of their delivery.

Mr Hux moved a resolution in conformity with the Chairman's suggestion. If one man more than another had done good to the Institute it was Mr. Hislop. When he entered upon the office he had great difficulties to contend with. He had succeeded in reducing the large debt of the Institute, and bringing it into its present somewhat more satisfactory state.

Mr. Jackson seconded the motion. The services rendered to the Institute by Mr. Hislop were so well known that it would ill become him (Mr. J.) to make any observations on them. It was much to be feared that they would never meet his like again, but it was to be hoped that some person would undertake the office with similar principles to guide him.

Mr. Brooks supported the motion. Mr. Hislop was worthy of all the honour that the Institute could pay him.

The resolution was passed unanimously.

Mr. Hislop returned his hearty acknowledgements. He had carried out the duties of Honorary Secretary under peculiar circumstances, and the greatest reward he could have was the appreciation of his services. If they thought that he had done so to the best of his abilities he was amply repaid for what he had done. He could only wish that he could get some help. He did not think it likely that he could continue in his present office much longer, and hence the significant words "*pro tem.*" after the word "Secretary," which the Chairman had been pleased to comment upon. At any rate if the Institute increased much in number it would be impossible for him to perform the duties of Honorary Secretary. But under any circumstances as long as he lived he should remain connected with the Institute, to which he hoped to be long able to render service in some capacity.

The Editor of the Horological Journal.—Mr. Hislop proposed a vote of thanks to Mr. Strachan. His position was one of difficulty, and considerable work in preparing papers for the Journal. He (Mr. H.) happened to know that the condition in which they reached the Editor was anything but that of a state fit to be presented to the public.

Mr. Jackson seconded the resolution.

Carried unanimously.

Mr. Strachan acknowledged the compliment, and said that the Journal was not all that he could wish; but if the members would assist by contributing to its pages to a much greater extent than they had hitherto done, it would perhaps become more creditable and useful than it was.

Mr. Klaftenberger moved and Mr. Blackie seconded a vote of thanks to the Chairman which was carried, *nem. con.*

The Chairman briefly returned thanks.

The Press.—Mr. Hux moved a vote of thanks to the Press, particularly the Clerkenwell News, which had always fought their battles.

Seconded and carried.

The proceedings then terminated.

AN OLD FRIEND WITH A NEW FACE.

The following modification of a form of watch known as the "Blind Man's Watch," recently effected and patented by Mr. E. D. Johnson, will, we think lead to the extension of the use of this instrument. The convenience of the repeating-watch must have led to an extensive sale amongst several classes, viz., invalids, travellers, and others, requiring to ascertain the time at night, independently of those who would use them as a luxury, had not their great cost acted as a bar still further increased by the expense of cleaning and repairing, charges amounting to something like fourfold those of plain watches.

The "Touch-Watch," was originally

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designed for the use of the blind, and was characterized by an external index on the back of the case to be moved by the finger.

Many modifications of this have appeared lately with the evident intention of stimulating their use, but all these modifications have so interfered with the external appearance of the watch that there was ample room for the improvement that Mr. Johnson appears to have effected. It is doubtful if much originality can be claimed for any of the parts of the contrivance, but the arrangement of the whole is so complete that we see no reason why they should not now come into general use.

The peculiar mechanism is as follows:—

The set square of an ordinary three-quarter plate watch, carries a pinion, driving another pinion of same size and number of leaves on the upper plate for the purpose merely of reversing the motion, this latter pinion is part of a short train of wheels—value 12 to 1—the twelve-hour wheel moving loosely on the arbor of the setting square, and standing in the centre of the upper plate. This wheel carries a click and spring to arrest a stop, or a hole to catch the point of a click as preferred, and projects through the dome or inner bottom of the case.

The outer bottom of the case is double the inner skin, being the real bottom, the outer skin being false and movable, turning on a boss projecting from its inner or concave surface, and having its edge concealed in a groove round the true bottom, a steel button screwed to the aforesaid "boss" fastens the false bottom on, and serves to connect the outer bottom and the movement by a stud or click which it carries, and applies when turned round to the hole or click carried by the twelve-hour wheel.

Thus, by having twelve little beads of gold soldered on the edge of the case, and one to serve as an index on the bottom, the time as shewn by the watch may readily be felt without interfering with the form of movement, the appearance of the watch, the winding, the setting of hands, &c., &c., with small addition to the first cost, and we see nothing to get out of order, nor to demand extra care, either in the use or the cleaning. The inventor asserts that the first expense is "final."

BOND'S SPRING GOVERNOR.

To the Editor of the Horological Journal.

Sir,—At a meeting of the Royal Astronomical Society last month, the subject of driving clocks for equatorials was discussed, and Mr. Carrington is reported to have said, "as a controlling power, independent of the moving force, he recommended an escapement, invented by Richard Bond." This escapement so far as I know is not figured in any work, though known as "Bond's Spring-governor," and as very excellent results have been obtained by its use, and as moreover the subject of driving clocks for equatorials, is now occupying a good deal of attention, it would doubtless be very interesting to many of your readers if some one of your scientific contributors would furnish a drawing of it. The celebrated American Alvan Clark uses the spring-governor in his equatorials, and Mr. Bond in the *Monthly Notices of the Astronomical Society*, vol. xvii., page 232, says, "It has been found, from several years practical application, to be the most perfect regulator of rotary motion yet devised."

In volume xi., of the *Monthly Notices*, p. 164, the following description of the spring-governor is given, which would, however, be much more interesting if accompanied by a good figure of the escapement. "The train of wheels which communicates the motive power to the cylinder connects with a small fly-wheel. This fly is for supplying momentum, and holds no part in the regulation. Beyond this fly, reckoning from the cylinder, is a half-seconds pendulum, with a dead-beat escapement. The connection between the escapement wheel and the fly is through a short spring. The elasticity of this spring allows the motion of the escapement wheel to be completely arrested at each vibration of the pendulum, while the momentum of the fly, acting for a small fraction of a second only on the spring, keeps up the motion of the cylinder. The machinery is thus completely under the control of the pendulum. No accumulation of irregularity can take place beyond the limits of the bending and unbending of the connecting spring. After this is adjusted to its minimum, the continuous rotary motion will be performed with all the accuracy of the beats of the pendulum for any length of time. It is, in fact, a complete solution of the difficulty of producing exact uniform motion."

The above account is taken from a "Description of the Apparatus for Observing Transits, by means of a Galvanic Current, now used at the Observatory of Cambridge, U. S. By Mr. G. P. Bond." The spring-governor is employed to drive the cylinder for the registration of the transits.

Your's, &c. G. H.

Edgbaston, Birmingham.

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A NEW RAILWAY SIGNAL.—Travellers on the Midland Railway, passing Kegworth, may have observed at that place a new signal, which is likely to cause a revolution in railway signals. It consists of a clock, with a face four feet in diameter, placed on the top of a column fifteen feet high. Only a quarter of the clock is shown, which is formed of ground glass, with red figures, 0. 5. 10. 15., and has only one hand. Attached to the clock is a long rod connected with a treadle about sixteen feet long, which lies along the inside of one of the rails. On the train passing over the treadle it is depressed slightly by the wheel flange, and the clock hand is set at liberty and is so adjusted by a counterpoise that it turns to the figure 0. Immediately the train is passed over, the hand begins again to mark the time up to fifteen minutes, when it is stopped, thus indicating to the next train exactly how long up to fifteen minutes the preceding train has passed the signal. The same clock works two faces, one for the up and one for the down line. The signal is illuminated at night. The simplicity of this signal is such that it is almost an impossibility for it to get out of order, and it is so arranged that a passing train takes off all pressure from the clock, so that the great difficulty hitherto experienced in self-working signals is successfully overcome. The Midland Railway Company, who have erected the one above described, have every reason to be satisfied with the result of the experiment. It is calculated that when adopted double the quantity of night trains may be safely passed over the line that can be passed over now. There can be little doubt that it will prevent a great number of accidents from trains running into each other, and, placed at mouths of tunnels, will be of great service. The inventor of this ingenious contrivance is Mr. John King, lace manufacturer, Heanor.—*Mechanics' Magazine.*

[We copy this from the *M. M.* How far the instrument described trenches upon the invention and patent of Mr. Funnell, of Brighton, we do not know, but we have seen his signal which is an instrument in the form of a large dial, with wheelwork, regulated by a short pendulum, the machine setting itself in motion without handling. It is wound up by every passing locomotive, depressing a lever reaching to the rail, displaying at the same moment the red or danger signal, which remains visible for a certain number of minutes, and is followed by the green signal "or caution," also remaining for a certain time only, and finally giving place to the white "all clear." Of course simple colours serve for day and lights by night. We have inspected this instrument and see no reason to doubt its perfect efficiency.]

METRIC WEIGHTS AND MEASURES.—Mr. W. Ewart, chairman of the select committee of last year upon the subject, has proposed a bill for decimalising our weights and measures. The bill would not come into operation until after three years from its passing. The system proposed would rest upon the metre, which was originally based on the ten-millionth part of the distance from the equator to the pole. The bill proposes to enact that the unit of the measure of length shall be the new yard, or metre, of 39 inches and 37,079 hundred-thousandths of an inch; that the unit of the measure of surface shall be the square of the new yard, except that the square of 100 new yards shall be the unit of land measure, and shall be denominated the new acre, or "hectare;" that the unit of the measure of capacity shall be the new quart, or "litre," the cube of a tenth of the new yard; and that the unit of weight shall be the weight of a new quart of distilled water, to be denominated the "kilogram," the half of which shall be the new pound, consisting of 1 lb. 1 oz. 3 drams, and 326 thousandths of a dram avoirdupois. The thousandth part of the kilogram to be called the "gram," and to be used in pharmacy and for weighing bullion and precious stones. Tables would be issued by the Board of Trade showing the proportion of these to the old weights and measures. There would be penalties for using the old weights and measures.

THE POWER OF THE SUN.—Every mechanical action on the earth's surface, every manifestation of power, organic or inorganic, vital and physical, is produced by the sun. His warmth keeps the sea liquid and the atmosphere a gas, and all the storms which agitate both are blown by the mechanical force of the sun. He lifts the rivers and the glaciers up the mountains, and thus the cataract and the avalanche shoot with an energy derived immediately from him. Thunder and lightning are also his transmuted strength. Every fire that burns and every flame that glows dispenses light and heat which originally belonged to the sun. In these days, unhappily, the news of battle is familiar to us, but every shock and every charge is an application, or mis-application, of the mechanical force of the sun. He blows the trumpet, he urges the projectile, he bursts the bomb. And, remember, this is not poetry, but rigid mechanical truth. He rears, as I have said, the whole vegetable world, and through it the animal; the lilies of the field are his workmanship, the verdure of the meadows, and the cattle upon a thousand hills. He forms the muscle, he urges the blood, he builds the brain. His fleetness is in the lion's foot; he springs in the panther, he soars in the eagle, he slides in the snake. He builds the forest and hews it down—the power which raised the tree and which wields the axe being one and the same. The clover sprouts and blossoms, and the scythe of the mower swings by the operation of the same force. The sun digs the ore from our mines, he rolls the iron, he rivets the plates, he boils the water, he draws the train. He not only grows the cotton, but he spins the fibre and weaves the web. There is not a hammer raised, a wheel turned, or a shuttle thrown, that is not raised, and turned, and thrown by the sun. His energy is poured forth into space, but our world is a halting-place where his energy is conditioned. Here the Proteus works his spells."—*Professor Tyndall's Heat considered as a Mode of Motion.*

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METEOROLOGICAL OBSERVATIONS

Taken at 9 A.M., JUNE, 1863.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	30·292	55	51	59	47	SE	3	bc	bc
2	30·171	58	54	66	47	SSE	3	bc	bc
3	30·013	64	57	74	52	W	2	c	cb
4	30·005	63	55	78	58	W	2	cb	cb
5	30·021	60	54	70	50	NW	4	o	rr
6	29·470	53	52	60	52	W	5	o	ptl, r, c
7	29·508	56·5	53	63	50	W	2	cb	pq
8	29·516	55·5	50·5	61	51	W	4	bc	ptlq, bc
9	29·778	57	51	63	48·5	W	3	cb	pq, r, o
10	29·567	60	56	63	51	SE	2	o	o, qq, c
11	29·592	57	50	65	50	WSW	4	c	c, rr
12	29·482	56	51·5	63	49·5	SSE	3	bc	rt, or
13	29·742	56	52	62·5	49	NW	2	o	o, r o
14	30·028	59	54	64	48	NW	3	o	op
15	30·009	60	55	65	57	NW	3	o	o, bc
16	29·994	60	57	66	53	SSW	2	o	o, rr
17	29·888	59	55·5	64	54	NW	2	o	c, b
18	29·897	60	56	68	52	WSW	2	cb	cb, rr
19	29·561	57	56 5	67	55	NE	2	rr	r, cb
20	29·748	61	57·5	66	52	N	1	bc	cb
21	30·044	62	57	69	52	NW	2	bc	bc
22	30·084	60·5	59	72	57	SW	2	o	o, cb
23	30·130	61	56	68	58	W	2	bc	bc, r
24	30·115	63	59	74	58	NNW	1	o	o, rtll
25	30·116	62	58	74	59	NNW	2	o	o bc,
26	30·183	61	58	73	52	W	1	o	bc, op
27	29·989	58	56	71	53	SW	5	o	cb
28	29·980	59	53	68	50	NW	3	o	cb
29	30·011	58·5	51	65	51·5	W	3	o	cb
30	30·191	59	54	68	50	W	3	c	bc
	29 904	59	54·6	67	52.2		2·6		Mean.

REMARKS.

The atmospheric pressure was greatest on the 1st at 8 a.m., being 30·30, and lowest about 11 p.m., 10th, 29·34, hence the range was 0·96 of an inch.

According to the table, W winds prevailed on 17 days, N on 6; E on 3; and S on 4.

The rain amounted to 4·05 inches on 15 days, during about 75 hours. From noon 5th to 9 a.m., 6th, 0·94 inch of rain fell, the wind being from S to W, fresh. From 2 to 11 a.m., 19th, 1·71 inches of rain fell, the wind NE, light;—an extraordinary downfall. From 8 p.m., to 1 a.m., 25th, there was very much lightning, with occasional thunder, and heavy showers, wind NNE light. The excessive rain-fall of June has counteracted the deficiency of the preceding three months.

Indications for August.

The middle day comprises 14h 30m. at London. The mean temperature of the *day* is 71°·5, of the *night* 53°·5. Notwithstanding the sun's rays fall upon us more obliquely during this month than in July, their heating effect is considerably assisted by the warm earth which radiates heat to the air. The average barometric pressure is 29·98 with a mean range of 0·8 inch. The prevalent winds are from W to N; and the average rain-fall 2·5 inches for 16 rainy days.

Indications for September.

From sunrise to sunset on the middle day is about 12h 40m. The mean *day* temperature is 67°; *night*, 49°. The barometer averages 30 inches, with a mean range of 1 inch nearly. Predominant winds S to W. Average rain-fall 2 inches on 12 days.

Indications for October.

The middle day is about 10h 35m. The highest *day* temperature average 58°; the lowest *night*, 44°. The mean height of the barometer is about 29·8 inches, with a mean range of 1·2 inches. The winds are most frequent from S to W; with equinoctial gales. The rain-fall averages 2·8 inches on 16 days.

Indications for November.

The length of the middle day is about 8h 50m. The mean pressure of the air is about 29·9 inches of the barometer, which has a mean range of 1·5 inches. The highest *day* temperatures averages 50°; the lowest at *night*, 38°. The winds are oftenest SW, but northerly are frequent. The mean amount of rain is 2·7 inches on 15 days. The month is considered the wettest of the year, and is characterized by stormy weather, overcast sky, occasional fog, with intervals of very fine days with clear frosty nights.

Obituary.

It is our painful duty to record the death, after a lingering illness of nearly two years, of Mr. GEORGE BRUTON, the well-known enameller, of 9, Spencer Street, Clerkenwell, on June 6th, at the early age of 31. He was a member of the Institute almost from the commencement, and took an earnest interest in its welfare.

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The Journal may also be had at the following Watch Tool Warehouses:—Delolme's, Rathbone-place; Ehnhuus, 53, Frith-street, Soho-square; Grimshaw, 159, Goswell-street; E. Hunt, Ironmonger-street; Lowther, Red Lion-street; Muller, King-street, Soho; E. J. Thompson, 5 & 6, Percival-street; Williamson, Frederick-place; Stevens, Goswell-road; Haswell, Spencer-street; C. B. Johnson, Market-place, Prescot, Lancashire; Margetts, "P.O." Goswell-street; and of all Booksellers in Town or Country.

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THE

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THE

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VOLUME VI.

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THE

HOROLOGICAL JOURNAL.

VOLUME VI.

SEPTEMBER 1, 1863.

TO OUR READERS.

In commencing a new Volume of the *Horological Journal*, we deem it right to explain its present position, and to point out the proposed alterations, which we hope may turn out to be improvements, and may render this publication more interesting and useful.

When the *British Horological Institute* was first established, one of the earliest plans by which its interests were sought to be promoted, and its influence increased, was that of the establishment of a Journal to be devoted to the Science of Horology, and the advantage of the profession. No such a publication in the English language then existed, and the only way in which scientific or practical communications could be made public, was through the medium of various scientific periodicals. It is very doubtful whether such media of communication were effective for the end desired, for few really practical men were in the habit of consulting these authorities. The promoters of the new Journal had themselves felt this want deeply, but they saw that great obstacles must be met and overcome. Among these obstacles was the fact that the contributions must necessarily be gratuitous, and the officers of the Institute being entirely honorary, and the finances limited, it was evident that the Journal must be managed by unpaid efforts.

A commencement was however made, and the Journal has now reached its Sixth Volume. We cannot say that we are satisfied with the results that have been attained, but we may be assured that the *Horological Journal* is an accomplished fact. It has won for itself a position in the scientific literature of the day, and forms a most valuable adjunct to the Institute, both as a medium of communication, and as a means of profit.

Arrangements have now been made for the improvement of the appearance of the Journal. We shall henceforth issue it with a coloured wrapper, which will form an admirable vehicle for advertisements, both of a trade and general character. It is proposed that the subject matter of its pages shall not be so very closely confined to the art as has hitherto been the case, but shall also embrace subjects of collateral interest. In carrying out these and other alterations, we have to beg the co-operation of our readers. We can only exist by voluntary contributions, and it cannot be expected that two or three persons, however willing they may be to do a large share of the work, should subject themselves for ever to a sort of philanthropic martyrdom.

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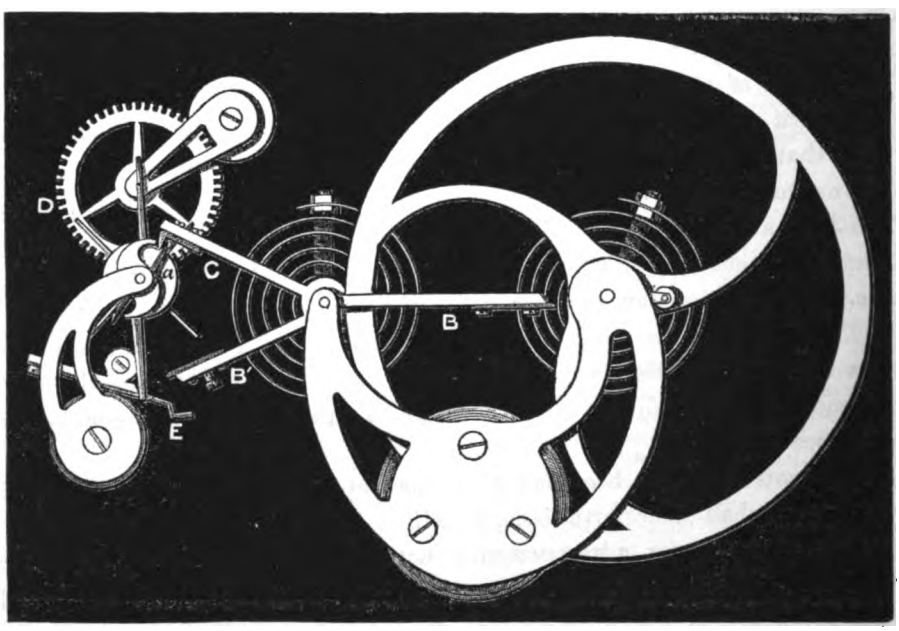
Our readers will therefore see that the excellence and varied interest of this Journal, not to speak of its prosperity, is in their own hands. If it were a source of private gain or interest, it must stand or fall with the efforts of its promoters. But it is the embodiment of an effort for public good, by means of mutual assistance, and can therefore only exist by the aid of liberal contributions of material by those for whom it is especially intended.

A TRUE DETACHED ESCAPEMENT,

WITH VARIABLE IMPULSE TO NEUTRALIZE THE EFFECT OF CHANGE OF TEMPERATURE ON THE PENDULUM SPRING.

In this escapement the impulse to the balance is in no way connected with the prime mover, and is consequently not influenced by any unequal transmission of power in the driving train. Being disentangled from this source of error, the next object was to maintain an equal amount of motion in the balance, which could not be accomplished with an absolutely invariable impulse, by reason of the effect of change of temperature on the pendulum spring; this will explain the adoption of the second spiral spring as the impelling force. It is of the same length and weight as the pendulum spring. Thermometric change affects them EQUALLY AND AT THE SAME TIME. Relatively, they are invariable; in mutual action—absolutely—the impulse is variable.

The writer ventures to submit that the object is accomplished without complication or mechanical difficulties of construction. There are but one pair of pivots, carrying one moving piece in connection with the balance, and that piece moving through a small angle. The construction of the ordinary lever escapement encourages me in the hope that it will do no violence to received opinions.



On reference to the engraving, it will be seen that the whole consists of three distinct parts:—1st, the Balance (A), mounted on a short spindle or staff, to the bottom of which is attached the pendulum spring. On one arm of the balance, near the centre, is a small roller, on which the impulse is given.—2nd, the Y piece, or impulse lever (BB'), also mounted on a short spindle, to the bottom of which is attached a similar spring to that on the balance staff, and which forces one

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of the short ends of the Y piece, carrying the pallet (C) against the scape wheel.—3rd, the scape wheel and locking arms, mounted on a spindle, at the bottom of which is a pinion gearing into the driving train through the wheel (D). The vertical space between the pinion and the scape wheel is occupied by a "fly," the four vanes of which are shown. At the top of the scape wheel, and on the same spindle, is a transverse piece, somewhat longer than the extreme diameter of the scape wheel, or double cam. It has a few degrees of angular motion between banking pins, and by a hair spring arranges itself across the highest points of the cams. The driving train is held in check by the locking arms at the detent (E).

The engraving represents as follows:—The driving train is locked by the detent (E). The Y lever is forced from the lowest to the highest point of the cam which has passed out of action, but the projecting nib on the Y lever pallet having detained the short lever or flirt piece in its motion with the scape wheel, is by it prevented from returning to its normal position, or holds in check the returning force of the impulse spring. Now, supposing motion be given to the balance, the roller coming in contact with the long end of the Y lever releases the transverse or flirt piece, and leaves the Y piece free to move, and its reaction gives the necessary impulse to the balance. The train is unlocked by the end of the Y piece (B) AFTER the longer end has left the roller on the balance.

The drawing is one-half the size of the actual working model, which makes 17 beats per minute, or a fraction over 3½ seconds per beat, the balance moving about 10 degrees over the revolution each way. The slow motion was intended to facilitate the detection of any irregularity by means of a vernier attached.

It will be observed that in this escapement the impulse is given at the end of the stroke. A gentleman connected with this Journal, to whom I submitted my escapement, very kindly pointed out my error, and gave me such information as enabled me to modify it, so as to give the impulse at the centre of vibration, and I hope to give an account of it in a future number. GEORGE HAWKSLEY.

May 18th, 1863.

[The above contrivance is by a gentleman who is not a member of the profession, and is interesting as showing how different minds will seek to attain the same end by different means. The idea that the two springs by their opposite actions would neutralise the effect of temperature is clearly a mistake, as the angular motion of the balance necessarily far exceeds that of the detent. There are other ideas which are suggested by the example before us, which might be efficiently worked out with advantage.] Ed. H. J.

EXTRACT FROM PROFESSOR AIRY'S REPORT

TO THE BOARD OF VISITORS OF THE ROYAL OBSERVATORY, GREENWICH.

"CHRONOMETERS, COMMUNICATIONS OF TIME, LONGITUDES, ETC.—The number of chronometers on hand at this time is 132; of these, 82 are compared with a standard clock every day, and the others are compared on one day in every week. The standard clock is one of a series of galvanic clocks whose movements are necessarily synchronous with that of the Motor Clock, which is accurately adjusted to Mean Solar Time by means of a galvanic action upon its pendulum, that can be used for any arbitrary length of time to accelerate or retard the clock by slow degrees during that time. Every chronometer, whatever be the reason of its lodgment at the Royal Observatory, is tried during some part of its stay in the heated Chronometer Oven.

When it is necessary to decide on the merits of chronometers, either as affecting their price for purchase, or as deciding their place in the published Order of Merit, the decision is made by me. The repairs of chronometers the property of the Government, are entirely managed by me.

The drop of the Time-Signal-Ball at Deal, by a galvanic current from this Observatory, which is automatically given by the corrected Motor Clock, is perfectly efficient, no failures occurring except from the defects of adjustment of the clock at the London Bridge Station, which changes the connections of wires. Time Signals are sent daily along the principal lines of railway, the most distant points (I believe) being Glasgow and Cardiff. I have also heard that the companies through whose offices the wires pass, have begun to distribute branch signals to private factories.

The clocks of the General Post Office are connected as formerly with the Observatory; each of four clocks being adjusted by current from our Motor Clock once every day, and reporting itself to us twice every day. The clock of Westminster Palace has also been brought into connection, the attendant receiving a signal from us once every hour, and the clock reporting its state to us twice every day. As far as I have yet observed, the rate of this clock may be considered certain to much less than one second per week."

[It is not quite clear to us whether we are to attribute the above wonderful rate to the going of the clock, or to the assistance rendered to it by galvanic current from Greenwich.] Ed. H. J.

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NAME OF MAKER.	No.	Whether Pocket, 2, or 8 Days.	ADDRESS OF MAKER.	Construction of Escapement and Balance, from the Description furnished by the Maker.
Simpson & Roberts.	1161	2	34, Strand street, Liverpool	Kullberg's balance, consisting of a bar and two rims without auxiliary
Kullberg	457	2	12 Cloudesley terrace, Islington, London	Original balance, consisting of a bar and two rims, "reversed arrangement," without auxiliary
Poole	3315	2	57, Fenchurch street, London	Auxiliary compensation to the bal.
Poole	3325	2	57, Fenchurch street, London	Auxiliary compensation to the bal.
J. Muirhead & Son. .	3129	2	Glasgow	Poole's auxiliary
J. Campbell . . .	897	2	7, South Castle street, Liverpool	Ordinary construction of balance, with a slight alteration
Lister and Sons . .	589	2	Newcastle-upon-Tyne	Poole's auxiliary
Reid and Sons . .	1220	2	41, Grey st., Newcastle-upon-Tyne	Ordinary constuction
Eiffe.	562	8	7, Orange street, Red Lion square, London	Auxiliary compensating power for the chronometer by application to the pendulum spring
Parkinson & Bouts .	1084	2	59, Gracechurch street, London	Ordinary construction, with a slight alteration to balance
C. M. Frodsham, jun.	3338	2	84, Strand, London	[No information received]
C. Frodsham . . .	3155	2	84, Strand, London	[No information received]
Timewell	1236	2	22, Stanley road, Balls Pond road, London	Improved gridiron balance
Parkinson & Frodsham	3474	2	4, Change alley, Cornhill, London	Auxiliary to ordinary construction of balance
Webb	5448	2	4, Pullen's row, Islington, London	Auxiliary compensation to the bal.
T. Campbell . . .	904	2	7, South Castle street, Liverpool	Balance of ordinary construction, with a slight alteration acting in extreme temperatures
Cribb	696	2	30, Southampton row, Russell square, London	Auxiliary compensation to the bal.
Parkinson & Frodsham	3701	2	4, Change alley, Cornhill, London	Auxiliary to ordinary construction of balance
Brunton	555	2	3, America square, John street, Minories, London	A new auxiliary to balance
C. M. Frodsham, jun.	3258	2	84, Strand, London	[No information received]
Hutton	548	2	10, Mark lane, London	Hartnup's balance
Lister and Sons . .	592	2	Newcastle-upon-Tyne	Poole's auxiliary
Mercer	656	2	45, Spencer st., Goswell rd., London	Original auxiliary compensation
Wood	490	2	69, Lord street, Liverpool	New arrangement of compensation
Reid and Sons . .	1228	2	41, Grey st., Newcastle-upon-Tyne	Ordinary construction
Webb	5458	2	4, Pullen's row, Islington, London	Auxiliary compensation to the bal
Glover	321	2	4, Swinton street, Gray's Inn road, London	Auxiliary compensation acting in cold
Roskell	1753 4878	2	21 & 23, Church street, Liverpool	Hartnup's balance
French	21334	2	9, Royal Exchange, London	Auxiliary compensation
C. Frodsham . . .	3188	2	84, Strand, London	[No information received]
Sewill	1742	2	61, South Castle st., Liverpool	Auxilary acting in cold
Clark and Son . .	3135	2	Greenock	Poole's auxiliary
J. J. Muirhead . .	7278	2	90, Buchanan street, Glasgow	Auxiliary to balance
Gowland	2658	2	Sunderland	Auxiliary compensation
Roskell	1754 6572	2	21 & 23, Church street, Liverpool	Auxiliary Compensation on Molyneux's principle
Timewell	1238	2	22, Stanley road, Balls Pond road, London	New auxiliary compensation
Crisp.	440	2	81, St. John street road, London	Auxiliary compensation
Moore	3357	2	114, High street, Belfast	Poole's auxiliary

* During these weeks the Chronometers were tried in cold; in the two weeks commencing January 11 they were exposed to the external air outside a North window; in the four weeks commencing February 8 (excepting the last two days of the week, March 1 to 8) they remained in the Chronometer Room, the North windows being left open.

† During these weeks the Chronometers were placed in the chamber of a stove heated by gas. A larger number of Chronometers than usual having been this year deposited for trial, it was found that the stove was not sufficiently large to contain the whole of them at the same time. They were in consequence formed into two divisions, and whilst one division was placed in the stove, the other remained in the ordinary temperature of the room. In all cases in which a maker had deposited two Chronometers for trial, one Chronometer was placed in each division.

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(III.)—ABSTRACT OF THE PRINCIPAL CHANGES OF RATE

Whether placed in Division I. or II.	First Day of First week of Rating.	Last Day of Last Week of Rating.	No. of Weeks.	Least Weekly Sum.	In what Week.	Greatest Weekly Sum.	In what Week.	Difference between the Greatest and Least.	Greatest Difference between one Week and the next.	Before and after what Day.
				s		s		s	s	
II.	Jan. 11	July 19	27	−11·1	April 12 to 19†	− 0·2	May 31 to June 7	10·9	5·7	Feb. 8*
II.	Jan. 11	July 19	27	−10·0	January 11 to 18*	+ 1·1	Mar. 29 to Apr. 5†	11·1	6·7	† Apr. 12†
I.	Jan. 11	July 19	27	− 2·7	Mar. 29 to Apr. 5	+ 8·8	May 31 to June 7†	11·5	6·8	Feb. 8*
II.	Jan. 11	July 19	27	− 6·4	Apr. 26 to May 3	+ 5·8	June 28 to July 5†	12·2	6·9	† July 5
I.	Jan. 11	July 19	27	− 3·0	May 24 to 31†	+ 9·9	April 5 to 12	12·9	7·6	* Jan. 25
I.	Jan. 11	July 19	27	+ 0·9	January 11 to 18*	+15·4	May 31 to June 7†	14·5	7·1	† June 7
I.	Jan. 11	July 19	27	− 5·1	February 1 to 8	+11·7	June 14 to 21	16·8	6·2	Feb. 8*
I.	Jan. 11	July 19	27	− 7·7	March 15 to 22†	+ 4·9	June 14 to 21	12·6	8·9	* Mar. 8†
I.	Jan. 11	July 19	27	−27·3	March 15 to 22†	−12·1	July 12 to 19	15·2	7·9	Feb. 1
I.	Jan. 11	July 19	27	−15·9	January 18 to 25*	− 0·3	May 3 to 10	15·6	7·7	* Mar. 8†
II.	Jan. 11	July 19	27	− 2·1	April 19 to 26	+12·7	May 31 to June 7	14·8	8·5	† Apr. 12†
I.	Jan. 11	July 19	27	− 4·6	March 8 to 15†	+ 7·9	January 11 to 18*	12·5	10.3	* Jan. 25
I.	Jan. 11	July 19	27	− 1·5	February 1 to 8	+22·0	July 12 to 19	23·5	5·0	† May 31†
I.	Jan. 11	July 19	27	+ 3·0	May 31 to June 7†	+20·6	July 12 to 19	17·6	8·2	† June 7
I.	Jan. 11	July 19	27	−20·4	March 15 to 22†	− 4·9	June 14 to 21	15·5	9·5	† Mar. 29
II.	Jan. 11	July 19	27	− 3·4	April 5 to 12†	+11·4	July 12 to 19	14·8	10·0	Mar. 29†
I.	Jan. 11	July 19	27	− 4·3	March 8 to 15†	+12·7	May 31 to June 7†	17·0	8·9	June 28
II.	Jan. 11	July 19	27	− 9·3	February 1 to 8	+ 5·7	June 14 to 21†	15·0	10·9	June 7†
II.	Jan. 11	July 19	27	−14·0	February 1 to 8	+ 4·6	July 12 to 19	18·6	9·2	June 7†
I.	Jan. 11	July 19	27	−11·4	January 18 to 25*	+ 9·4	July 12 to 19	20·8	8·3	Apr. 26
II.	Jan. 11	July 19	27	+ 7·1	April 12 to 19†	+26·2	March 1 to 8*	19·1	9·2	June 7†
II.	Jan. 11	July 19	27	−10·3	April 19 to 26	+ 6·2	June 28 to July 5†	16·5	11·9	† July 5
II.	Jan. 11	July 19	27	−15·1	April 12 to 19†	+ 3·2	July 5 to 12	18·3	11·0	* Jan. 25
II.	Jan. 11	July 19	27	+13·4	February 1 to 8	+38·3	June 28 to July 5†	24·9	7·9	* Jan. 25
II.	Jan. 11	July 19	27	− 4·6	January 18 to 25*	+24·2	July 12 to 19	28·8	6·1	* Feb. 15*
II.	Jan. 11	July 19	27	−12·5	April 5 to 12†	+ 6·6	July 5 to 12	19·1	11·4	Feb. 8*
II.	Jan. 11	July 19	27	−16·7	Mar. 29 to Apr. 5†	+ 4·1	July 12 to 19	20·8	10·8	June 7†
I.	Jan. 11	July 19	27	+15·9	January 11 to 18*	+47·7	June 7 to 14	31·8	5·5	Feb. 8*
I.	Jan. 11	July 19	27	− 0·5	March 8 to 15†	+24·9	May 31 to June 7†	25·4	9·7	* Mar. 8†
II.	Jan. 11	July 19	27	− 6·3	Mar. 29 to Apr. 5†	+17·0	July 12 to 19	23·3	11·0	† Apr. 19
II.	Jan. 11	July 19	27	− 5·9	Jan. 25 to Feb. 1	+17·8	July 12 to 19	23·7	10·9	* Jan. 25
I.	Jan. 11	July 19	27	− 3·2	February 1 to 8	+18·7	July 5 to 12	21·9	12·2	Feb. 8*
II.	Jan. 11	July 19	27	−11·8	February 1 to 8	+ 5·5	June 28 to July 5†	17·3	14·6	Feb. 8*
I.	Jan. 11	July 19	27	−20·1	January 18 to 25*	+ 9·9	July 12 to 19	30·0	8·7	* Mar. 8†
II.	Jan. 11	July 19	27	−34·8	April 5 to 12†	−12·6	May 10 to 17	22·2	12·7	† Apr. 19
II.	Jan. 11	July 19	27	+ 0·8	February 1 to 8	+27·6	June 28 to July 5†	26·8	10·4	Feb. 8*
II.	Jan. 11	July 19	27	−14·8	February 1 to 8	+ 6·7	June 28 to July 5†	21·5	13·5	Feb. 8*
II.	Jan. 11	July 19	27	−19·4	April 12 to 19†	+ 3·8	January 11 to 18*	23·2	13·1	Feb. 8*

The order of arrangement of the Chronometers in this table is determined solely by consideration of their irregularities of rate, as expressed in the columns "Difference between the Greatest and Least" and "Greatest Difference between one Week and the next."

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NAME OF MAKER.	No.	Whether Pocket, 2, or 8 Days.	ADDRESS OF MAKER.	Construction of Escapement and Balance, from the Description furnished by the Maker.
Owen Owens . . .	$\frac{6}{115}$	2	4, South Castle street, Liverpool	May's centripetal balance
Crisp.	380	2	81, St. John street road, London	Auxiliary compensation
Dent.	3009	2	61, Strand, London	Dent's patent balance; see pamphlet "On the Errors of Chronometers," p. 23
Porthouse	7228	2	16, Northampton square, Goswell road, London	Auxiliary to balance
Gowland	2659	2	Sunderland	Auxiliary compensation
McGregor and Co. .	3324	2	38, Clyde place, Glasgow, and 8, William street, Greenock	Poole's auxiliary
Hiatt	1050	2	5, Bath street, Liverpool	Hartnup's gridiron balance
Glover	315	2	4, Swinton street, Gray's Inn road, London	Auxiliary compensation acting in cold
Hennessy	3213	2	5, Wind street, Swansea	Poole's auxiliary
E. J. Dent. . . .	23182	2	33, Cockspur street, London	Ordinary bal., with slight alteration
Parkinson & Bouts .	1131	2	59, Gracechurch street, London	Ordinary construction, with a slight alteration to balance
Pennington and Co.	1537	2	7, Wigmore street, Cavendish square, London	Ordinary construction
McGregor and Co. .	2534	2	38, Clyde place, Glasgow, and 8, William street, Greenock	Auxiliary, acting in cold
Hiatt.	985	2	5, Bath street, Liverpool	Hartnup's gridiron balance
Sewill	1681	2	61, South Castle street, Liverpool	Auxiliary, acting in both extremes
Wood	357	2	69, Lord street, Liverpool	New arrangement of compensation
Cribb	727	2	30, Southampton row, Russell square, London	Auxiliary compensation to the bal.
Russell and Son . .	6325	2	30 & 32, Slater street, Liverpool	Auxiliary compensation on Molyneux's principle
Dent.	3024	2	61, Strand, London	Dent's patent balance; see pamphlet "On the Errors of Chronometers," p. 23
Dell, Brothers . .	1441	2	Broad street, Bristol	Original unpublished compensation
Hewitt and Son . .	2614	2	12, John street, Mildmay park, Kingsland, London	Hewitt's auxiliary compensation
French	$\frac{21}{1257}$	8	9, Royal Exchange, London	Auxiliary compensation
Joyce Murray. . .	439	2	8, Wood street north, King's square, London	Molyneux's auxiliary
Frodsham & Baker .	6220	2	31, Gracechurch street, London	Ordinary balance
Reynoldson . . .	7245	2	18, Queen street, Hull	Auxiliary to balance
Blackie	511	2	24, Amwell street, Clerkenwell, London	Auxiliary compensation to the bal.
Pennington and Co.	1519	2	7, Wigmore street, Cavendish square, London	Ordinary construction
Dobbie	2192	2	Clyde place, Glasgow	Ordinary construction
Hewitt and Son . .	2531	2	12, John street, Mildmay park, Kingsland, London	Hewitt's auxiliary compensation
Dell, Brothers . .	1449	2	Broad street, Bristol	Poole's auxiliary compensation
Jürgensen	8899	P	Copenhagen	Anchor escapement
Jürgensen	8898	P	Copenhagen	Anchor escapement
Frodsham & Baker .	6223	2	31, Gracechurch street, London	Auxiliary to balance
Millidge and Son. .	364	2	28, Princes street, Edinburgh	A new auxiliary, unpublished
Kullberg	375	2	12, Cloudesley terrace, Islington, London	Original balance, consisting of a bar and flat rim, without auxiliary

* During these weeks the Chronometers were tried in cold; in the two weeks commencing January 11 they were exposed to the external air outside a North window: in the four weeks commencing February 8 (excepting the last two days of the week, March 1 to 8), they remained in the Chronometer Room, the North windows being left open.

† During these weeks the Chronometers were placed in the chamber of a stove heated by gas. A larger number of Chronometers than usual having been this year deposited for trial, it was found that the stove was not sufficiently large to contain the whole of them at the same time. They were in consequence formed into two divisions, and whilst one division was placed in the stove, the other remained in the ordinary temperature of the room. In all cases in which a maker had deposited two Chronometers for trial, one Chronometer was placed in each division.

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(III.)—ABSTRACT OF THE PRINCIPAL CHANGES OF RATE—*concluded.*

Whether place Division I or II.	First Day of First Week of Rating.	Last Day of Last Week of Rating.	No. of Weeks.	Least Weekly Sum.	In what Week.	Greatest Weekly Sum.	In what Week.	Difference between the Greatest and Least.	Greatest Difference between one Week and the next.	Before and after what Day.
				s		*s*		*s*	*s*	
I.	Jan. 11	July 19	27	−16·4	January 18 to 25*	+ 6·5	May 31 to June 7†	22·9	13·7	† June 7
I.	Jan. 11	July 19	27	+12·2	March 1 to 8*	+35·6	{My. 31 to Jun. 7† / Jun. 28 to July 5}	23·4	13·7	† June 7
I.	Jan. 11	July 19	27	−16·6	March 15 to 22†	+ 7·4	June 14 to 21	24·0	13·7	† Mar. 29
I.	Jan. 11	July 19	27	−16·0	February 1 to 8	+12·4	June 28 to July 5	28·4	11·7	Feb. 8*
II.	Jan. 11	July 19	27	−12·5	January 11 to 18*	+23·4	July 12 to 19	35·9	8·3	Mar. 29†
I.	Jan. 11	July 19	27	− 2·0	February 1 to 8	+18·0	January 18 to 25*	20·0	16·4	Feb. 8*
II.	Jan. 11	July 19	27	−27·1	June 7 to 14†	− 9·3	May 31 to June 7	17·8	17·8	June 7†
I.	Jan. 11	July 19	27	− 1·4	{Jan. 11 to 18* / Jan. 18 to 25*}	+34·9	July 12 to 19	36·3	9·1	† Mar. 29
II.	Jan. 11	July 19	27	−16·0	January 18 to 25*	+13·7	July 12 to 19	29·7	12·5	* Jan. 25
II.	Jan. 11	July 19	27	−16·3	Mar. 29 to Apr. 5†	+ 6·6	May 31 to June 7	22·9	17·0	Mar. 29†
II.	Jan. 11	July 19	27	−22·8	January 18 to 25*	+ 2·8	July 12 to 19	25·6	16·0	June 7†
II.	Jan. 11	July 19	27	−27·4	June 7 to 14†	− 3·5	January 18 to 25*	23·9	17·2	June 7†
II.	Jan. 11	July 19	27	−23·0	Jan. 25 to Feb. 1	+23·1	July 5 to 12	46·1	8·7	† Apr. 5†
I.	Jan. 11	July 19	27	−40·8	January 18 to 25*	−14·2	July 12 to 19	26·6	18·9	* Mar. 8†
I.	Jan. 11	July 19	27	−31·7	January 18 to 25*	+ 3·3	May 31 to June 7†	35·0	15·8	† Mar. 29
I.	Jan. 11	July 19	27	− 6·1	March 8 to 15†	+18·5	February 8 to 15*	24·6	22·4	* Mar. 8†
II.	Jan. 11	July 19	27	−31·1	Apr. 26 to May 3	+ 5·4	January 11 to 18*	36·5	16·7	† Apr. 19
II.	Jan. 11	July 19	27	− 4·8	March 1 to 8*	+35·2	June 28 to July 5†	40·0	15·2	June 7†
II.	Jan. 11	July 19	27	− 4·0	Jan. 25 to Feb. 1	+37·9	July 12 to 19	41·9	16·3	† Apr. 19
I.	Jan. 11	July 19	27	−26·0	April 12 to 19	+ 8·4	March 8 to 15†	34·4	21·6	* Mar. 8†
II.	Jan. 11	July 19	27	−26·7	January 11 to 18*	+33·5	July 5 to 12	60·2	10·8	* Jan. 25
II.	Jan. 11	July 19	27	− 4·0	March 8 to 15	+35·9	June 28 to July 5†	39·9	21·9	Mar. 29†
I.	Jan. 11	July 19	27	−24·5	March 8 to 15†	+ 5·3	{April 12 to 19 / June 14 to 21}	29·8	27·0	† Mar. 29
I.	Jan. 11	July 19	27	−28·1	May 31 to June 7†	+15·0	April 19 to 26	43·1	20·7	* Mar. 8†
I.	Jan. 11	July 19	27	−17·6	January 11 to 18*	+29·5	July 12 to 19	47·1	19·1	* Jan. 25
I.	Jan. 11	July 19	27	−25·5	Jan. 25 to Feb. 1	+ 5·1	January 18 to 25*	30·6	30·6	* Jan. 25
I.	Jan. 11	July 19	27	−38·1	January 11 to 18*	+11·8	July 12 to 19	49·9	23·2	* Jan. 25
I.	Jan. 11	July 19	27	− 1·9	May 31 to June 7†	+35·0	March 1 to 8*	36·9	31·3	* Mar. 8†
I.	Jan. 11	July 19	27	−20·4	March 15 to 22†	+27·8	June 14 to 21	48·2	29·5	† Mar. 29
II.	Jan. 11	July 19	27	−62·9	January 11 to 18*	+ 6·8	July 12 to 19	69·7	20·8	June 7†
II.	Jan. 11	July 19	26	−19·2	April 12 to 19†	+43·1	Jan. 25 to Feb. 1	62·3	25·4	* Jan. 25
I.	Jan. 11	July 19	27	−30·1	March 1 to 8*	+18·5	May 24 to 31†	48·6	38·4	* Mar. 8†
II.	Jan. 11	July 19	27	− 8·6	May 24 to 31	+44·3	June 14 to 21†	52·9	36·6	June 7†
I.	Jan. 11	July 19	27	−17·3	January 18 to 25*	+91·3	July 12 to 19	108·6	17·7	† Mar. 22†
I.	Jan. 11	June 14	22	+ 1·6	Jan. 25 to Feb. 1	+17·6	May 3 to 10	16·0	8·3	Apr. 26

The order of arrangement of the Chronometers in this Table is determined solely by consideration of their irregularities of rate as expressed in the columns "Difference between the Greatest and Least" and "Greatest Difference between one Week and the next."

The Chronometer Kullberg 375 changed its error 83s.1 between May 29 and May 30, and was removed from trial by the maker on June 16. Its rates are in consequence not comparable with those of the other Chronometers and it is placed by itself at the foot of the Table, instead of being included in the general list. In forming the numbers for this Chronometer given in the above Table, the rate for the week in which the great change of error took place is not taken into consideration.

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EXTRACT FROM A PAPER ON

ALUMINIUM BRONZE,

READ AT A MEETING OF THE ROYAL ASTRONOMICAL SOCIETY, BY

LIEUT. COL. A. STRANGE, F.R.A.S.

"The alloy called Aluminium Bronze was first, I believe, made by Dr. Percy five or six years ago, and is composed of Aluminium and Copper in various proportions. Ten per cent. of Aluminium, however, giving the best material for mechanical purposes.

"The qualities of most importance in instrument making are: (1) Tensile strength; (2) Resistance to compression; (3) Malleability; (4) Transverse strength or rigidity; (5) Expansive ratio; (6) Founding qualities; (7) Behaviour under files, cutting tools, &c.; (8) Resistance to atmospheric influences; (9) Fitness to receive graduation; (10) Elasticity; (11) Fitness for being made into tubes; (12) Specific gravity.

"Of these, tensile strength, resistance to compression, and malleability, were most obligingly tested for me by Mr. Anderson, at the Royal Gun Factory, Woolwich; and the other qualities by Messrs. Simms, by whom the great Theodolite is now being constructed. I will take the above enumerated properties in their order, premising that to have obtained results of an absolute and final character would have involved more time than I could spare, and that, therefore, those which follow, though sufficiently reliable for almost any practical purpose, are open to the correction of more extensive experiments.

"(1.) TENSILE STRENGTH. This was tried some years ago by Mr. Anderson, with the following results:—

	Breaking strain.
Aluminium Bronze . .	95,747 } lbs. per
Gun Metal	32,000 } square inch.

"Mr. Anderson was good enough to try it again for me in September last, and states in his report, 'the average tenacity of this metal proved to be 22 tons 12 cwt. (50,624 lbs.) breaking weight per square inch in the two specimens tested; elongations did not take place until 4,300 lbs. in the one case, and 3,600 lbs. in the other had been applied, when a permanent elongation was noticed of ·009 of an inch in the first specimen, and ·034 of an inch in the last.' Mr. Anderson adds that the specimens were not quite sound.

"In the above cited report, Mr. Anderson gives a higher tensile strength to gun metal than before, namely, 17 tons (38,080 lbs.) for the average of the '*best specimens*' tested at the gun factories.

"Combining the results, we have the average breaking tensile strength of the two metals as follows:—

$$\left.\begin{array}{l}\text{Aluminium Bronze} \quad \dfrac{95747 + 50624}{2} = 73{,}185 \\ \text{Gun metal} \quad \dfrac{32000 + 38080}{2} = 35{,}040\end{array}\right\} \text{lbs. per square inch.}$$

the ratio being 1 to 0·48, or rather more than 2 to 1 in favour of Aluminium Bronze.

"For the purpose of comparing the tenacity of the new alloy with steel, we have data, given by Mr. Anderson in a lecture* on Materials for Rifled Cannon, in which he states that cast steel varies in tensile strength from 114,000 to 67,000 lbs. per square inch; but he objects to the higher qualities as liable to brittleness, and prefers, where great strains are in question, an average quality of cast steel breaking at 80,000 lbs., and he adds, that specimens from a gun made of Krupp's famous cast steel, characterised by 'softness' (which Mr. Anderson considers favourable to tenacity) and 'perfect soundness,' gave 72,000 lbs. per square inch, which we see is 1,185 lbs. less than the average strength of Aluminium bronze above given.

"(2.) RESISTANCE TO COMPRESSION. Mr. Anderson reports on this as follows:—'The ultimate amount of compression applied was 59 tons 2 cwts. 1 qr. 4 lbs., (132,416 lbs), under which the specimen † became too much distorted to permit of more weight being applied with any true result. Compression was not perceptible until 9 tons 2 cwts. per square inch (20,384 lbs.) was applied, when the specimen suddenly gave to the extent of ·006 of an inch, and on the weight being removed an elasticity of ·001 was observed, which gives the first permanent compression as ·005 of an inch.'

"The compressive strength of cast iron varies a good deal. That of 'Carron iron, No. 3,' the highest given in Ure's Dictionary of the Arts, is 115,542 lbs. per square inch; but it is difficult to compare, in this respect, two metals whose behaviour under compression is so different: cast iron yielding suddenly and almost totally, and the new alloy more gradually and partially. Astronomical instruments, however, are more dependent on the rigidity or resistance to a transverse force than to any other quality

"(3). MALLEABILITY. Mr. Anderson states on this head:—'The qualities of this metal for forging purposes would appear to be excellent. With the exception of the part heated to a red heat in the shade, all show that it is a good workable material under the hammer, almost up to melting point.'

"I may add that there were specimens in the Exhibition, showing that the alloy could be drawn out under the hammer almost to a needle's point.

"I come now to the experiments tried by Messrs. Simms.

"(4). TRANSVERSE STRENGTH. As the absolute determination of the force necessary to break, or permanently bend a bar of metal, was beyond our appliances, I begged Messrs. Simms to be satisfied with a comparative value of the rigidity of the new alloy; that is, to ascertain the relative resistances of gun metal, brass, and aluminium bronze, to a force insufficient to produce permanent flexure. This they succeeded in doing, and report as follows:—

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* Published in No. XXIII Journal Royal United Service Institution.

† "The specimen subjected to this enormous pressure, distorted though it is, does not exhibit the trace of a fissure. The cohesion of its particles is inviolate."

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"'The same weight applied to three bars altered the index of our instrument as under:—

Brass	2·22 divisions.
Gun Metal	0·15 „
Aluminium Bronze	0·05 „

"Hence, aluminium bronze would appear to be three times more rigid than gun metal, and upwards of forty-four times more rigid than brass.

"(5.) EXPANSIVE RATIO. This determination was also a comparative one. Messrs. Simms found that 'aluminium bronze is less affected by change of temperature than either gun metal or brass (a little less than gun metal, and much less than brass).'

"(6.) FOUNDING QUALITIES. Regarding this, there is ample experience. The alloy produces admirable castings of any size.

"(7.) BEHAVIOUR UNDER FILES, CUTTING TOOLS, ETC. In this respect, also, it leaves nothing to be desired. It does not clog the file; and in the lathe and planing machine the tool removes long elastic shavings, leaving a fine, bright, smooth surface.

"Messrs. Simms state—

"'It can be worked with much less difficulty than steel, and we should think that screws made of it would (notwithstanding the original great cost of the metal) prove in the end less expensive than screws made of steel.'

"(8). RESISTANCE TO ATMOSPHERIC INFLUENCES. Messrs. Simms state, 'it does not readily tarnish.' This, likewise, is entirely a relative question. Absolute inoxidizability, however desirable, is hardly to be expected. Suffice it, that the new alloy tarnishes much less readily than any metal usually employed for astronomical instruments; viz., gun metal, brass, silver, cast iron, or steel.

"(9). FITNESS TO RECEIVE GRADUATION. Messrs. Simms state, 'Aluminium Bronze takes a fine division, and it will not be necessary to inlay another metal, as is usually done, to receive the graduation.' This opinion is fully justified by the specimen of graduation executed by Messrs. Simms, the lines of which are remarkably pure and equable, characteristics never presented, in the same degree, they inform me, by lines cut on any other cast metal. May not this superiority indicate that the alloy in question is peculiarly homogeneous? The lines are very distinct under the microscope, notwithstanding the yellow colour of the metal.

"(10). ELASTICITY. I possess no direct experiments bearing on this point. But that the alloy has considerable elasticity is unquestionable. I may here state that an eminent Parisian instrument maker informed me that of all the wires tried for the suspension of Foucault's Pendulum, for illustrating the rotation of the earth, none, not even those of steel, were so durable under that severe ordeal as wires made of Aluminium Bronze. It would appear, therefore, to be the most proper material for the suspension springs of clock pendulums.

"(11.) FITNESS FOR BEING MADE INTO TUBES. It admits of every process necessary for this purpose. It can be soldered with either silver or brass solder; it can be rolled into sheet metal; and it can be hammered and drawn. Hitherto telescope tubes, the cones of transit axes, the pillars of altazimuths, &c., have been made almost exclusively of yellow brass, a metal very deficient in rigidity. Gun metal does not admit of being rolled, and has, therefore, never been used for the tubular parts of instruments, for which the new alloy seems pre-eminently suitable.

"(12.) SPECIFIC GRAVITY. The specific gravity of alloys of aluminium and copper, as determined by Messrs. Bell, are—

3 per cent.	of Aluminium	8·691
4 „	„	8·621
5 „	„	8·369
10 „	„	7·689

The last named, which is best for the purposes now under notice, is very nearly the same as that of wrought iron, and less than that of either brass or gun metal.

"It appears from these experiments, and from the concurrent testimony of those who have given it a fair trial, that the 10 per cent. Aluminium Bronze is far superior, not in one, or some, but in every respect, to any metal hitherto used for the construction of philosophical apparatus, and that for such purposes it may be employed in the dimensions that would be proper in the case of cast-steel. All parts which otherwise would be made of steel, may, with perfect safety, and even with advantage, be made of the new alloy; particularly such parts as bolts, and fixing, tangent, and micrometer screws. Its hardness and comparative inoxidizability point it out as peculiarly adapted for pivots, axes, and bearings. If employed for receiving the graduation of circles, the necessity for inlaying another metal will be obviated, by which two advantages will be gained: the hammering, which forms part of the operation of inlaying, and which, more or less, must cause unequal density and tension in the circle subjected to such treatment, will be dispensed with, and the effect of inequality of expansion in the circle and the inlaid strip will no longer be a cause of apprehension. With respect to the due visibility of divisions cut on this metal, opinions will perhaps differ. I can only say that I should be well content to observe with them.

"The use of this alloy for the construction of the new Great Theodolite is, in the opinion of Messrs. Simms, and in my own, fully justified by what we now know of it, and the effect of using it will be to keep the weight of the instrument within reasonable limits, notwithstanding its possession of means and appliances not hitherto bestowed on such instruments.

"Two points remain:—the making of the alloy, and its cost.

"The metal Aluminium is at present extracted in England by one firm only, Messrs. Bell Brothers, Newcastle, under a licence from M. Deville, the French discoverer of the process. I have met with instances of failure in making the alloy with copper. Two main points only, however, seem to require particular attention. First, extremely pure copper must be used. The best is copper deposited by electricity, but that kind is very expensive; the next best is copper from Lake Superior, which makes an alloy of excellent

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quality. The ordinary coppers of commerce generally fail, owing, it is said, chiefly to the presence of iron, which appears to be specially prejudicial. The second precaution is to re-melt the alloy two or three times. The first melting of 10 Aluminium and 90 Copper produces an alloy of excessive brittleness. Each successive melting, up to a certain point determined by the working, and particularly the forging properties of the metal, improves its tenacity and strength. It is probable that after several meltings there will remain in combination with the copper a somewhat smaller proportion of Aluminium than 10 per cent.

"The present price of the English made 10 per cent. Aluminium Bronze is 6s. 6d. per lb., but there is reason to believe that, as the process of extracting the Aluminium becomes more largely practised, and the demand for the metal increases, the price will fall. The above price is four or five times that of gun metal. A much smaller quantity, however, of the new alloy than of gun metal will give the same strength, and when it is considered how small a ratio the cost of the material bears to the cost of workmanship in refined apparatus, it will be found that even at the present price of the new alloy, its cost is not prohibitory, whilst the advantages attending its use promise to outweigh the increased expenditure.

"In the foregoing paper, which I am aware is very imperfect and incomplete, I have sought no more than to contribute such an instalment of practical information regarding this remarkable material as may be of service to those, who, like myself, contemplate making use of it, of whom I trust there will be many, for by its use we shall, I venture to think, confer on such structures, at once greater strength, and less weight, and so diminish tension, flexure, and distortion, to an extent calculated sensibly to improve the higher order of instruments of physical research."

BRITISH HOROLOGICAL INSTITUTE.

STATEMENT OF RECEIPTS AND DISBURSEMENTS FROM JUNE 13TH TO DECEMBER 13TH, 1862.

Dr.	£.	s.	d.
To Balance in hand at last audit . .	11	2	8½
„ Donations and Subscriptions .	85	11	0
„ Cash received for Journals . .	16	12	3
„ Cash received for Advertisements	45	2	8
„ Rent from Mr. Palmer	15	0	0
„ Sundries	3	2	1
	£176	10	8½

Cr.	£	s.	d.
By Rent, Taxes, and House Expenses	40	12	2
„ Salaries, Wages, and Commission	41	4	10
„ Printing, Engraving, and Binding Journals	56	13	0
„ Stationery, Stamps, and Account Books.	5	10	9
„ Newspapers, Periodicals, &c. . .	2	11	4½
„ Printing, Advertising, &c. . .	3	3	1
„ Mr. Palmer, care of premises. .	15	13	6
„ Sundries	1	19	2
„ Balance in hands of Treasurer .	8	8	0½
„ Ditto in hands of Hon. Sec. . .	0	14	9½
	£176	10	8½

We have examined the Balance Sheet, together with the entries for the past half-year, and find the same to be correct,

JOHN EVANS,
DENNIS GUNTON,
W. G. SCHOOF, } *Auditors.*

December 22nd, 1862.

BALANCE SHEET OF RECEIPTS AND EXPENDITURE FROM DECEMBER, 1862, to JUNE, 1863.

Dr.	£.	s.	d.
To Balance in hand at last audit . .	9	2	10
„ Donations and Subscriptions. .	144	13	6
„ Cash received for Journals . . .	18	11	9
„ Ditto received for Advertisements	16	2	3
„ Sundries, Dinner Tickets, &c. . .	21	5	0
„ Rent received from Mr. Palmer.	10	0	0
	£219	15	4

Cr.	£.	s.	d.
By Rent, Taxes, and House Expenses	37	11	5½
„ Salaries, Wages, and Commission	41	12	2
„ Printing, Engraving, and Binding Journals.	65	5	0
„ Annual Dinner disbursements .	33	18	0
„ Stationery, Stamps, and Account Books	5	16	4½
„ Printing, Advertising, &c. . .	5	7	10
„ Newspapers, Periodicals, &c. . .	2	13	11
„ Mr. Palmer, care of premises .	10	9	0
„ Sundries	3	10	3½
„ Cash in hands of Treasurer. .	13	5	9½
„ Ditto in hands of Hon. Sec. . .	0	5	6
	£219	15	4

We have examined the above Account, together with the Vouchers, and find the same to be correct,

JOHN EVANS,
CHARLES BACON,
W. G. SCHOOF, } *Auditors.*

22nd June, 1863.

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METEOROLOGICAL OBSERVATIONS,
Taken at 9 A.M., JULY, 1863.
Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	°	°	°	°				
1	30·335	62	54	69	50	SSE	4	bc	b, cb
2	·043	63	57·5	74	58	SSW	5	c	cb
3	·182	62	56·5	70	53	WNW	3	c	cb, b
4	·296	60	57	72	54	SW	2	bc	b
5	·324	64	56	73	56	E	2	bc	b
6	·311	65	60	75	56	E	2	b	b, bc
7	·069	70	62	77	59	NW	2	bc	b, o
8	·186	63·5	59	78	57	WNW	2	o	cb, b
9	·260	64	59	72	58	NW	2	b	b, bc
10	·360	66	59·5	80	59	NNE	2	b	b
11	·405	68	60·5	82	58	E	1	c	bc
12	·373	68	61	79·5	60	SE	1	bc	b
13	·473	66	60	82	63	N	3	o	cb, m
14	·440	63	58	74	54	NNW	1	m	mb, b
15	·256	63	60	77	52	WNW	2	bc	b, cb
16	·213	63·5	57	81	58	SE	3	cb	cb
17	·075	59	53·5	69	51	W	3	o	o, b, o
18	29·789	56	49	71	48	W	5	c	p, cb
19	30·011	56	49	64	46	NW	2	bm	o, bc
20	29·837	57	51	68	51	NW	2	bc	bc
21	·808	58	53·5	66	51	Calm	0	or	rr
22	·494	61	59·5	62	57	S	5	or	r, o
23	·885	57·5	52·5	65	50	W	3	cb	bc
24	30·125	57	52	67	47	NW	3	cb	b, cb
25	29·962	61·5	56	66	53	NW	5	c	cb, r
26	30·105	56	52	65·5	49	N	3	o	b
27	30·225	58	55·5	68	52	Calm	0	mb	b
28	·110	63	58	73	52	WSW	1	b	bc
29	·036	63	59	73	54	NNW	1	c	cb
30	·220	61	55	75	54	NNE	2	b	b
31	·318	61	55	73	50	E	3	cb	bc
	31·145	61·8	56·4	72	54		2·4	Mean.	

REMARKS.

In the first number of a new volume it may be desirable to explain that in these tables the general condition of the weather is recorded by letters, which signify as follows:—b, blue sky; c, clouds, or cloudy; f, fog; h, hail; l, lightning; m, mist, or haze; o, overcast; p, passing showers; q, squally; r, rain; s, snow; t, thunder; and a letter repeated denotes much, as ff, thick fog; rr, heavy rain:—that the force of wind is estimated by the "sea scale," 0 to 12,—0 being calm, and 12 the strongest hurricane:—that the barometer observations are all reduced to 32° F, at the mean sea-level:—and that the rain-gauge is on the ground, about 55 feet above the sea-level.

In July, the barometer was highest on the 13th, lowest on the 22nd, (see table); the extreme range being 0·98 inch.

On the 22nd, the wind was strong, reaching to a gale at night, from S. to W.

Rain fell on four days, during 20 hours, to the amount of 0·92 inch.

According to the Table, the wind blew from the N, on 9 days; E, 6; S, 4; W, 10; while there was calm on 2 days.

The barometer has been above the average; the temperature and prevalent winds have corresponded with the mean values; the rainfall has been very little, and the month unusually fine.

JÖRNS' TIMEPIECES.

Letters patent have been granted to HEINRICH JÖRNS, of *Tessin, Mecklenburg*, for improvements in clocks or timepieces.

This invention is designed for obviating the necessity for winding up clocks or timepieces periodically, as at present practised. It is proposed to effect this through the agency of the variations in the temperature of the atmosphere, which is constantly taking place both inside and outside of dwelling houses, and to employ the draught or current of air, caused by such changes of temperature, to set in motion certain mechanism to be connected to the ordinary mechanism of clocks, and by these means to produce a power sufficient to wind up a clock continuously, instead of having to wind it up by hand periodically, as at present practised. By this invention a great part of the weight at present necessary to keep the going parts of a clock in motion may be dispensed with; for example, a clock, which under ordinary circumstances would require four pounds to keep it going, may by this invention be kept going by the gravitating power of a weight of two ounces.

The following are examples of the means by which this invention may be carried into practical effect, that is to say:—The case containing the clock movements is formed with two vertical chambers, the foremost to contain the clock, and the back chamber for the passage of air by suitable inlet and outlet passages; the top or outlet passage aforesaid is provided with a flap valve, and the bottom or inlet passage is fixed with an ordinary revolving ventilator, upon the axis whereof a worm is formed, which gears into a worm-wheel for imparting rotary motion to wheelwork for winding up the going weight of the clock, by means of an endless cord passing over a series of pulleys suitably placed. The action of the foregoing mechanism is as follows:—Suppose the clock to be only partly wound up, in this case the flap valve aforesaid will be open; suppose, also, that there is a hole made in that part of the wall against which the clock is to be placed, the said hole will establish a communication, by means of the aforesaid air chamber, between the air both outside and inside of the room in which the clock is situated; and as the temperature of the air in the room varies from that outside of same, the effect will be to cause the air in the room to pass through the ventilator and outlet passage aforesaid, and thus impart motion to the winding mechanism connected therewith, and raise the going weight of the clock, and continue to do so until the weight is raised to its full extent; by which time a hook will have

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been brought into action, and lifted a sliding piece of metal and weighted lever connected to the outlet air passage aforesaid, and by these means close the said air passage, by which the action of the ventilator will stop, and the winding up of the clock cease, until the weight aforesaid again descends by its gravity, by which the outlet passage will be again opened, when the winding mechanism will again come into action, and again raise the going weight as before stated, and so on in succession, thus causing the said weight to be continually raised as it descends, the operation of winding being in effect self-winding, and constituting the feature of novelty in this invention.

[The above is extracted from the *Mechanics' Magazine*, and will doubtless afford some amusement to our readers.] Ed. H. J.

EQUATION OF TIME TABLE

For September, 1863.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *added* to Mean Time.
		m. s.	s.	m. s.
Tues . .	1	0 1·67	0·781	0 1·67
Wed . .	2	0 20·55	0·792	0 20·55
Thurs .	3	0 39·69	0·803	0 39·70
Fri . . .	4	0 59·10	0·813	0 59·12
Sat . . .	5	1 18·72	0·822	1 18·74
Sun. . .	6	1 38·57	0·831	1 38·59
Mon . .	7	1 58·59	0·839	1 58·62
Tues . .	8	2 18·81	0·846	2 18·84
Wed . .	9	2 39·18	0·852	2 39·22
Thurs .	10	2 59·70	0·858	2 59·74
Fri . . .	11	3 20·34	0·863	3 20·39
Sat . . .	12	3 41·11	0·867	3 41·16
Sun. . .	13	4 1·96	0·871	4 2·02
Mon . .	14	4 22·90	0·874	4 22·96
Tues . .	15	4 43·90	0·876	4 43·97
Wed . .	16	5 4·97	0·878	5 5·04
Thurs .	17	5 26·05	0·878	5 26·13
Fri . . .	18	5 47·13	0·878	5 47·21
Sat . . .	19	6 8·21	0·878	6 8·30
Sun. . .	20	6 29·31	0·877	6 29.40
Mon . .	21	6 50·36	0·875	6 50·46
Tues . .	22	7 11·34	0·872	7 11·44
Wed . .	23	7 32·23	0·868	7 32·34
Thurs .	24	7 53·01	0·863	7 53·12
Fri . . .	25	8 13·67	0·858	8 13·79
Sat . . .	26	8 34·18	0·851	8 34·30
Sun. . .	27	8 54·50	0·843	8 54·63
Mon . .	28	9 14·63	0·834	9 14·76
Tues . .	29	9 34·53	0·824	9 34·66
Wed . .	30	9 54·19	0·813	9 54·32

NEW GUN METAL.

Messrs. Deville and Carron have lately been making experiments on the properties of a new gun metal, a compound of silicium and copper. When copper contains rather less than 5 per cent. of silicium, it presents a fine bronze colour, is fusible, and rather harder than bronze,—but is perfectly ductile, and can be readily worked without clogging the tools, as bronze does. Its tenacity is remarkable, being equal to that of iron. Silicium is the basis of sand, and the manufacture of its compounds with copper may be made by fusing together a mixture of sand, sodium, and copper, with some common salt and fluor spar as flux. This process affords another example of the great use of sodium in the metallurgic arts; the commercial manufacture of aluminium and magnesium being entirely dependent on the cheapness of sodium for being economically conducted.—*Chemists & Druggists' Magazine.*

NOTICE TO MEMBERS.

A rough working model of Dr. Clark's Gravity Escapement, described in No. 59, p. 127, is now, through the kindness of Mr. J. F. Cole, being exhibited for a few days at the Institute.

ERRATA.

The following errors occurred in the copy of the Requisition for a Special Meeting contained in our last number—A. Ganard for A. Jaccard. Ganevel for Ganeval. L. Scheussler for L. Schuessler. Henry Shanter for Henry Shorter. J. Woodfall Howard for J. Woodfall Heward. J. T. E. Soller for J. H. Soller. J. R. Hux for R. R. Hux.

In Mr. Jones's speech, in the report of the half-yearly meeting, the quotation "Pro tempore longem" should have been *Pro tempore longo.*

TO CORRESPONDENTS.

All Communications for this Journal should be addressed to the EDITOR, *at the Office*, 35, Northampton Square, Clerkenwell.

Our pages are at all times open to correspondence and contributions, either original or compiled from good authorities.

We have received several letters, some complaining of the insertion of uninteresting reports of meetings of the members of the Institute; and others on the other hand, wishing for more extended, or, to use their own expressions, "fairer" reports. It is clear that we cannot comply with both these requests. On the one hand, it must be remembered that this Journal is the organ of the Institute, and a medium for distributing information amongst its members. Most of these members would not be pleased if they were not informed of the proceedings of general and annual meetings. On the other hand, it cannot be expected that our pages should be exclusively occupied with personal matters, which are interesting only to two or three individuals.

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RATES OF CHRONOMETERS.

Mr. Hartnup, of the Liverpool Observatory, has recently published some interesting tables (see p. 119, vol. v. of this Journal) containing the particulars of the rates of 1,700 chronometers, which were in use in voyages varying in length from a few weeks to twelve months and upwards. From these tables, it appears that with these seventeen hundred chronometers, the average error in a voyage of one month is six miles, in twelve months, 186 miles.

Dividing the whole number into hundreds, and subdividing them again into ten classes of ten each, he found that the error of the best ten in a month was not appreciable, in a twelvemonth it was equal to five miles. The worst ten show an error of 25 miles in a month's voyage, and 524 miles in a year.

It is by no means unlikely, that if we could readily get at the rate of going of the chronometers supplied to our mercantile marine, something in the same way that Mr. Hartnup has done at Liverpool, we should be startled at the very great departure from even moderate accuracy which is exhibited, even with all our modern appliances. We remember seeing somewhere, an advertisement recommending someone's lever pocket watches, in which it was stated that a ship's time had been better kept by one of them, than by its own chronometer. This appeared to us at the first blush as an outrageous puff. A little consideration of the conditions involved, showed that it was possible; and Mr. Hartnup's tables show that it is not only possible, but by no means unfrequent, that so-called marine chronometers go worse than a moderately good pocket watch. If this be so, need we wonder at the numerous wrecks of homeward-bound vessels on our coasts? And do not these facts point out to shipowners the folly of the penny wise and pound foolish principle of hiring chronometers, or of accepting rates taken at some period of time when the piece was in a different state to what it is when delivered? It is evident that there is yet much to be done in improving the average character of our time-keepers for marine purposes. We are not now speaking of those carefully-constructed instruments which come fresh from the hands of our best artists, such as were shown at the late Exhibition. We allude to the majority of those chronometers which are used in the merchant service. In the interests of our commerce, we must earnestly point out to merchants and shipowners the fact, that unless their chronometers are properly compensated, and rated from time to time, it would be as well to trust to a common watch as to such instruments. Even the best are liable to a few errors; but if neglected, or untested from time to time, these very chronometers, perfect though they may be in principle, and elaborate in construction, may swerve from the ascertained rate, and be thus reduced to the level of an ordinary time-keeper; while the instruments, with simple compensations, are entirely valueless under similar circumstances.

The question simply reduces itself to the same conditions as apply to all instruments of precision. They must be compared with a proper standard from time to time, their errors ascertained, and the necessary corrections be made. No amount of care in manufacture can make this simple procedure superfluous, and by following it out rigidly, we might get, even from our present instruments, a far more trustworthy set of rates than those shown by Mr. Hartnup's very valuable and suggestive researches.

M. PHILLIPS ON THE PENDULUM SPRING.

M. Phillips, C.E., of France, in a valuable treatise on the timing spring applied to chronometers and watches, describes, theoretically, through an elaborate series of algebraic equations, impossible to reproduce in our columns, were they intelligible even to the practical horologist, the properties of this spring, and demonstrates, in

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mathematical phraseology, the proper curves to secure isochronous results. As it is, we believe, the only published work existing on this important subject, we give a translation of the author's preliminary remarks:—

"In portable instruments constructed to measure time, it is understood that the spiral spring, with its balance combined, acts as the regulator, in the same way that the pendulum does to the stationary clock.

"Huyghens, who first applied the pendulum to clocks, is the inventor of the spiral spring, commonly termed the timing spring, which he first had made in 1674, by Mr. Thuret, a skilful horologist. The originality of this invaluable discovery was, indeed, disputed by Doctor Hook on one side, and on another by the Abbè Hautefeuille. But the result of all the long discussions to which this invention gave rise is, that Doctor Hook may have had the first idea of a straight spring applied to the balance; that the Abbè Hautefeuille might have curved it to a helical form acting in the direction of its axis; but that Huyghens alone perfected these crude ideas by giving to this spring the spiral form, which offering no obstruction to the vibrations of the balance, has made this regulator one of great precision. Finally, to P. Leroy we owe the discovery of the isochronous property of the timing spring in the suitable adjustment of its extremities.

"However important the consideration of this kind of regulator may be, the theory of its action had not hitherto been established. The essentially complex form of this spring, introducing, in the application of the theory of elasticity, differential equations of so complicated a kind that it would be absolutely impossible to mass them. I have been, however, by particular combinations, fortunate enough to overcome these difficulties, as far as this problem is concerned, and it is this theory which is the subject of this treatise. I therein consider the question as a problem of mechanics, which may be thus stated.

"Having a spiral spring fixed to a balance, it is required to know the laws of their common motion. In practice, allowance has evidently to be made for secondary details, such as the influence of oils, friction, &c. But, nevertheless, the solution and the rules which will be evolved, completely reach this problem, as absolutely as the theory of the pendulum does its application to the measurement of time. I should add, that I have submitted to the results of experiment, under the most varied circumstances, the conclusion I have deduced from the theory, and that in every case as satisfactory an agreement as could be wished for has ensued.

"Whether the inquiry concerns the flat spiral or the cylindrical spring, the extremities are alike fixed by pins at an angle, the one to a fixed stud, the other either to a collet or to a bar moving with the balance, and concentric with it. This mode of attachment shows the condition of its connection, and we may consider the fixed extremity of the spring as preserving an invariable inclination, and the other extremity as having a fixed inclination with respect to that of the circle of the collet at their point of intersection . . . The difference of construction between a spiral flat spring, and a spiral cylindrical spring is as follows:—The first is composed of a curved spiral plane, formed of a certain number of spirals, generally from eight to twelve, approaching as nearly as possible to a circular form, and following the circle of the balance collet, while the spirals of the cylindrical spring take an horizontal projection; an exact circular form whose centre is the balance axis, finishing generally by two gently inclined curves, which approach the centre at a distance usually about equal to half the radius. These spirals occupying a position one above the other, the true form of the spring is that of a screw of extremely close pitch, whence the name of the cylindrical spring.

"I take as my starting point, as I have done in my treatise on springs of railway carriages, the theory of the resistance of elastic solids, in which the existence of a neutral central axis is conceded and the change of curvature of the fibres without friction between each other.

"Further on I demonstrate that in the problem under solution, the ordinary theory of a neutral axis is a necessary part of the mathematical theory of elasticity, as it has been established chiefly by Navier, Cauchy, and M.M. Lamé and Clapeyron."

[The originality of this prime invention in horology is justly ascribed to our countryman, Doctor Hook. Derham, a contemporary, in his work, *The artificial clock maker*, says—"the first inventor was that ingenious and learned member of our Royal Society, the late Doctor Hook, who contrived various ways of regulation; one way was with a loadstone, another was with a tender straight spring, one end whereof played backward and forward with the balance, so that the balance was to the spring as the bob of the pendulum, and the little spring as the rod thereof; several other contrivances he had besides of this nature, as he assured me, and is manifest from divers evidences.

"But the invention which best answered expectation, was at first with two balances, of which I have seen two sorts, although there were several others; one way was without spiral springs, the other with, both agreeing in this, that the outward ring of the balances had a like number of teeth. The time of these inventions was about the year 1658, as appears among other evidence from this inscription upon one of the aforesaid double balance watches presented to King Charles II. Robert Hook, Invt., 1668, T. Tompion, fecit 1675."]

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NOTES ON THE MANAGEMENT OF CHRONOMETERS

AND

THE MEASUREMENT OF MERIDIAN DISTANCES.*

Captain Shadwell, recognizing the scientific character of the Horological Institute, very kindly sent a copy of the above-mentioned work to the Library, and we have for a long time felt it to be a duty to state our appreciation of the work publicly, and, although very late, we are now happy to be able to do so.

In the preface to the first edition, the author states:—"The important services rendered by chronometers in the ordinary course of navigation at sea, by facilitating the daily determination of the ship's position in longitude, are well understood and fully appreciated by all intelligent seamen; but in addition to the useful ends to which, under ordinary circumstances, they are subservient in the daily conduct of the ship's affairs, they are susceptible, when placed in intelligent hands, of being applied to higher scientific uses, and when rightly employed, are capable of affording valuable contributions towards the gradual perfection of maritime geography." The object of the author is mainly to instruct naval officers how to apply chronometers to these higher scientific uses. The work may be considered to consist of two parts, one treating of the *management* of chronometers, the other developes, with the utmost scientific precision, a plan for carrying out chronometric measurements of meridian distances. The treatises on navigation do not give instruction upon this latter subject sufficiently exact and definite for the purposes of marine surveying.

As a surveying officer who has done much service, and displayed much care and sagacity in using chronometers, he is a very competent authority upon the subject which he undertakes to expound. He has, moreover, made himself familiar with all existing writings upon the scientific employment of chronometers. The result consequently is, that he presents us with a work upon the practical uses of the chronometer, highly creditable to him as a naval officer and as a scientific writer. If we would make exception to our appreciation of this performance, it would be to say that, in our opinion, he wastes too much space in apologizing for his work, showing its necessity, and indicating and lauding the authorities whom he quotes. As regards these points, we believe the book could be abridged very much—to the advantage of the student and the navigator in saving them the perusal of matter with which they are not concerned, and to the author in rendering his work more unique and concise.

Having said so much of the work as a whole, we will take the liberty of placing before our readers some extracts from that portion of the book which treats of the management of chronometers. Writing upon the effects of magnetism, our author says:—"Undoubted instances are on record of the performance of chronometers being affected by the action of magnetic influences, chiefly owing to the fact of the balances having accidentally acquired polarity. Since attention has been drawn to this subject, and greater caution exercised in the construction of the balances and balance-springs so as to avoid this source of error, instances of this kind are no doubt now extremely rare, and quite exceptional in modern chronometers of good construction. We should, however, be taking a very limited view of the subject, were we solely to confine our attention to the consideration of *permanent* polarity in chronometer balances, and lose sight of a possibly more prolific source of error, which, in all probability, is caused by the *induced* magnetism of considerable masses of iron on ship-board, in various stages of development, varying in different positions of the ship, and change of magnetic latitude."

The following precautions against the effects of magnetism are suggested:—"The marks on the dial-plates of the chronometers should all occupy the same relative positions; that is, the line joining the twelve and six hour-marks should all be parallel to one another, in order that, retaining the same invariable position with reference to the fore-and-aft line of the ship, they may be similarly affected by the possible local magnetic attraction of the ship's iron, and that in cases where the balances of the chronometers have accidentally acquired any degree of polarity, their mutual influences on each other may be reciprocal. Proximity to any vertical iron stanchions or knees, arm-stands of muskets or rifles, any large masses of unmagnetised iron, and, in iron-built ships, vertical iron bulk-heads, should also, in all cases, be very carefully avoided."

In a note, we are informed that "Admiral Fitz Roy suggested, as the possible cause of the discrepancy existing in the Beagles chain of meridian distances, measured round the globe, which amounted to 33 seconds, that chronometers may be affected by magnetic action in consequence of a ship's head being for a considerable time in any given direction." On the other

* By Captain C. F. A. Shadwell, R N., C. B. London: J. D. Potter.

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hand, Mr. Airy, in a paper "on the magnitude of the magnetic forces in an iron ship," observes:—"I have never been in any part of a ship in which a chronometer would be placed, in which the compass-needle was reversed, or in which it followed rudely the movements of the ship; there are places possessing this character—as very near the funnel, or very near some iron stanchions or knees, but nowhere where a chronometer would probably be placed. That is to say—the ship's magnetic force (practically) is never equal to the earth's magnetic force, and the earth's magnetic force will never be doubled by the addition of the ship's force. Therefore, if the earth alone will not affect a chronometer, the earth and ship together will scarcely disturb it sensibly."

Of course Captain Shadwell duly estimates the importance of the effect of temperature upon the performance of chronometers; he treats the subject at much length and well, but we can only afford space for the following note:—

"MM. Delamarche and Ploix recently made some very interesting experiments on the effects of temperature on an *uncompensated* chronometer, placed at their disposal for that purpose by M. Bregret, a French maker of celebrity.

"The experiments were divided into two series, from May to September, and again during November and December, 1858, during which the chronometer was exposed to temperatures ranging from 32° to 95° F., while the corresponding rates were carefully observed.

The results showed a striking connection between the rates and the corresponding temperatures. At 32°, the observed rate was + 3m 33·5s, and at 95°, it was—2m. 52s. Between these two limits the rate constantly diminished as the temperature increased. The difference between these two extreme rates is 6m. 25·5s, which, divided by 63, gives 6·12 seconds as the average change due to one degree of temperature. Assuming, then, that the rate varied mathematically in proportion to the temperature; these gentlemen then formed a table giving the probable temperature corresponding to the observed rates, which was then compared with the observed temperatures. The column of differences in no case shows a greater variation than 1°6. In 115 differences, 77 are below half a degree, and in seven only some tenths above a degree. When we consider that these results may be affected by slight errors in the mode of determining the mean daily temperature, viz.:—by taking a mean of the indications of a maximum and minimum thermometer, they are certainly very remarkable; in fact, as MM. Delamarche and Ploix observe, "we are then justified in considering this uncompensated chronometer as a thermometer giving the mean temperature (in degs.) during the 24 hours, by a daily rate equal to + 3m. 33·5s—(6·12s)."

Some of the notes—for the most part translations from French writers—are peculiarly to the point; as for instance, those upon the causes of acceleration and retardation of rates, and the advisability of attending to the age of the oil, and the manner in which chronometers are affected by the thickening of the oil, as well as by temperature. It is the author's principal aim to show the necessity of applying to the rates of chronometers, when those instruments are employed in surveys for measuring meridian distances, a correction, which he terms an equation, for temperature. The problem is, to find the present rate of a chronometer from a series of errors found on different days not very remote. The "method of least squares" applied to this purpose, is satisfactory as a mathematical investigation, but is not at all suitable in practice, being far too tedious for any seaman, however painstaking.

The method of De Cornulier for equating for temperature in finding the rate of a chronometer is also far too intricate and mathematical. Lieussiou's formula for the same purpose, deduced by a graphical method of investigation, appears to deserve greater attention than it has had. It allows for temperature and the deterioration of the oil. Still simpler, if not so comprehensive, methods have been devised by Mouchez, and by Tiark. But of all the methods, Mr. Hartnup's appears to us to offer all that can be expected, if not all that could be desired, in rating a chronometer according to temperature indications. His recent comparisons of sea-rates and temperatures (published in our Vth volume) have satisactorily shown that his method is fundamentally correct.

The exposition of these various methods of deducing a rate in accordance with temperature for a chronometer while at sea, occupies a large portion of Capt. Shadwell's book. He has evidently spared himself no labour, and has endeavoured to place each fairly before the reader. Then follows examples of determining meridian distances from chronometers. They are not sufficient in number, and it appears to us that their solutions might have been more clearly stated. The method of exhibiting calculations practised by Riddle, in his work on navigation, is well worthy of imitation. It is the clearest that we know. "The shortest distance to a seaman's brain is through the eye," was remarked to us by one who knew them well. Perspicuity in arrangement of calculations is an essential feature in furtherance of comprehension.

In concluding this notice, it may be remarked, that officers of the Royal Navy are now required to keep a "Chronometer Journal," and to register therein, among other data, the daily indications of a maximum and a minimum thermometer, supplied for the purpose of being kept with the chronometers. As Capt. Shadwell well remarks: "change of temperature being now universally recognised as the principal cause of marked changes of rate, careful daily records of the actual temperature experienced by the chronometers during the periods of rating, and throughout the passages, become henceforth absolutely necessary and indispensable adjuncts in all reports of meridian distances. Even if the observer should not himself have employed them in his calculations, they should be furnished for the use of the hydrographers who may subsequently have occasion to subject their results to a critical examination."

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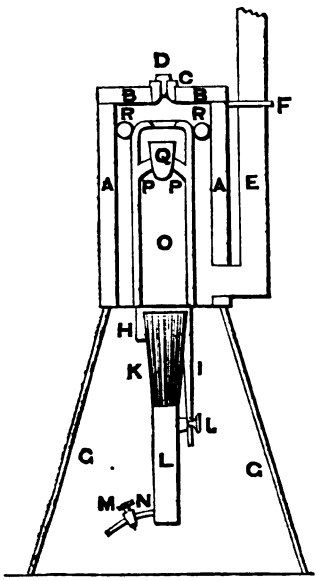
GORE'S NEW GAS FURNACE.

This ingenious and admirable furnace was constructed to supply a temperature equal to the fusing of cast iron, by means of coal gas and atmospheric air, without the use of a bellows or tall chimney. It is intended for scientific research, but its safety, simplicity, and efficiency have already led to its use by metal workers.

The smallest furnace, which consumes thirty-three feet of coal gas (value twopence) per hour, will melt eight ounces of copper, or six ounces of cast-iron. The next size furnace consumes about twice that quantity of gas, and will melt forty-five ounces of copper, or forty ounces of cast-iron. It is constructed as follows :—



A is a cylinder of fire-clay, about nine inches high and six inches diameter, open at both ends, and with a hole in its side near the bottom to lead into the chimney; it is covered by a moveable plate of fire-clay, B, with a hole in its centre, for introduction of the crucible, or of substances to be melted: this hole is closed by a perforated plug of fire-clay, C, for access to the contents of the crucible; and that again is closed by another stopper of clay, D. E, is a chimney of sheet-iron, about five or six feet high, kept upright by a ring of iron, F, attached to the top of the furnace.

The fire-clay cylinder is enclosed in a sheet-iron casing with a bottom of iron, to which are fixed three iron legs, G. An iron tube, H, with a prolongation, I, supports by means of the screw, J, the burner, K, and its tube, L, which is open at both ends. Gas is supplied to the burner by means of the tap, M, which has a small index, N, attached to it, for assistance in adjusting the gas.

Inside the larger cylinder is another fire-clay cylinder or cupola, O, with open ends, and with three projections of fire-clay, P, for supporting the crucible, Q; it is kept steady by means of three clay marbles, R.

The gas burner is a thin metal cylinder deeply corrugated at its upper end, with the corrugations diminishing to nothing at its lower end.

The action of this furnace is as follows:— Gas is admitted to the open tube, L, by the tap, M; it there mixes with air to form a nearly explosive mixture, which ascends through the burner and burns in the clay cylinder, O; being supplied with the remainder of air necessary to complete combustion through the tube, H. The flame and products of combustion pass up through the cylinder, O, and then downwards outside into the chimney; the point of greatest heat being at Q.

With one ounce of copper put into the cold furnace, and the gas lighted and properly adjusted, the copper generally begins to melt about the tenth or twelfth minute, and is completely melted by the fifteenth. With the heat well up, one ounce of copper has been melted in it in two minutes and a quarter, one ounce of cast iron in three minutes, five ounces of copper in four minutes and a quarter, and three ounces of cast-iron in five minutes. With the smaller hole in the top of the furnace open, one ounce of copper has been melted in three-and-a-half minutes, and several ounces of copper have been kept in fusion for upwards of half an hour, and may be kept so for any length of time. Cast-iron has also been fused and kept melted under the same conditions.

When it is desirable to perfectly avoid the contact of air with the fused substance during manipulation, a thin and narrow ring of fire-clay should be placed upon the top of the tube, O, to contract its opening; the flame then completely closes over the top of the crucible and prevents

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access of air. A proper adjustment of gas, together with exclusion of air in this manner, enables a perfectly bright surface of melted copper, or even tin, to be continuously maintained, from which the images of the parts above are clearly reflected.—*Chemist and Druggist.*

To the Editor of the HOROLOGICAL JOURNAL.

SIR:—I observe, in your last number, a notice of the Astronomer Royal's report about the Observatory at Greenwich, in which he speaks of the Westminster Clock in terms of praise, stating that it goes within less than a second a week. The words in which this is mentioned let out a thing or two, which, for the sake of the profession, requires a little explanation.

I should like, first, to enquire, if it is a fact that the Westminster Clock is jealously guarded from the public eye. Having cost somewhere about £20,000 of public money, and being, according to the accounts of its patrons, a first rate specimen of Horology, it surely should be accessible, if even for the purposes of study only.

The Astronomer Royal's report states that the clock is in electrical communication with Greenwich every hour. I am informed that there is a contrivance connected with it which sets the hands when the current passes, so that the movement only has to keep time between each hour. We are also told that there is an attendant there, I presume, to watch the performance and note the signals. Now Sir, I should like to ask whether an outlay of £20,000 is necessary for a clock to keep time for sixty minutes only, under the constant supervision of an attendant. Would not a tenth of that sum have been amply sufficient for such a purpose, or was the sum expended in experiments, all of which have failed, and made it necessary to have an attendant to keep the clock going?—I am, yours &c.

ENQUIRER.

[The following notice was forwarded to the Council of the Institute, together with a copy of an engraved portrait of M. Urban Jürgensen. We have much pleasure in inserting in the *Horological Journal* a notice of an horologist so celebrated, both as a practical and a literary member of the profession.]—ED.

HISTORICAL NOTICE

CONCERNING THE

JÜRGENSENIAN ESTABLISHMENT, AT COPENHAGEN.

In the year 1780, my grandfather, Mr. Jörgen Jürgensen, in partnership with Mr. Larpent, established a watch manufactory at a distance of twenty-seven miles from Copenhagen, at the village of Kirke-Hvalsöe, in the neighbourhood of Roeshilve, where upwards of 1500 very excellent pocket watches were made. During this period, Mr. Jörgen Jürgensen also had the management of his watch establishment at Copenhagen, till the year 1801, when his eldest son, Urban Jürgensen, after many years' sojourn in foreign countries, returned, and became his father's partner. From this moment, the manufacturing of watches of the most excellent description, according to the newest inventions and improvements of the art, became the chief object of their endeavours.

Mr. Jörgen Jürgensen died in the year 1811, and in the same year, my father, Urban Jürgensen, completed, according to Arnold's plan, his first chronometer, which was eminently successful. He had, indeed, before practised the higher branches of watch making, and composed a work upon it, as well in Danish (1804) as also in French (1805), which is held in high esteem in Denmark as well as in France; but, still, the year 1811 must be recorded as the date at which chronometers first were made in Denmark.

Urban Jürgensen, whose early decease (in 1830) must be lamented, as well on account of his art, as of his circle of friends, gave to the art of watchmaking in this country, partly by means of his writings, and partly by means of his instruction diffused from his establishment, a new impulse, and a more elevated direction. There have been numbered 750 watches, all of the most excellent description, and a peculiar construction; and also some forty chronometers and other philosophical instruments, which in his time were made in his establishment for the higher branches of watchmaking.

Since the death of my father, his establishment is carried on, and uninterruptedly continued by me and my brother, Jules Jürgensen. The firm being the establishment of Urban Jürgensen & Sons. Since the year 1834, when I returned home from my travels abroad, which had kept me three years-and-a-half absent, while I visited London, Paris, and other places, and when my brother, Jules Jürgensen set out in a similar tour, I have had the management of the Copenhagen

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establishment, which formerly was in No. 277, Dronningens Tvergade, and now for the last twelve years in No. 9, Gothersgude.

My late father's high theoretical attainments in those branches of science which were conducive to the improvement of his art, as well as his great practical skill and ingenuity, have been so amply tested and satisfactorily established by men of science, and naval officers in various parts of Europe, that filial piety need not add anything to enconiums so freely, so justly, and so generally bestowed.

Those readers who may feel an interest in the success of the establishment which is honoured with his name, and possibly may wish to ascertain how far his successors do credit to a name which, in every sense of the expression, lays them under heavy obligations, I beg leave to refer to the subsequent extract of a report from the combined commission of men of science and artists that arranged the Industry-Exhibition at Copenhagen in the years 1834, 1836, and 1840; and also to the prize-medals accorded to the establishment upon the award of the Jurors at the Great Exhibition of all Nations, London, 1851; and Paris, 1855.

LOUIS URBAN JÜRGENSEN

Copenhagen, 1862.

EXTRACT FROM A REPORT

OF A COMBINED COMMISSION OF MEN OF SCIENCE AND ARTISTS APPOINTED BY THE DANISH GOVERNMENT TO ARRANGE AN EXHIBITION OF INDUSTRY AT COPENHAGEN IN THE YEARS 1834, 1836, & 1840.

In the report of the Exhibition of 1834, which was published in the following year, the Commission alludes to the great influence which the enlightened and distinguished *Urban Jürgensen* has had in this country on the advancement of the art of watch making; and further observes, "that his establishment is, with praiseworthy diligence, carried on by his sons, *Louis* and *Jules Jürgensen*, both of whom have obtained a royal stipend for the purpose of perfecting themselves in their art by a sojourn abroad, and by whom three chronometers (one of these provided with a metal thermometer) have been sent to the Exhibition, besides several other watches for common use, with improvements partly invented by themselves and partly by others. All these watches are distinguished by an extremely accurate and tasteful execution, and are accordingly worthy of our undivided attention."

In the year 1836, a second Exhibition of Industry took place in the salons of the Academy of Arts, pursuant to an invitation of the aforementioned Commission. In the report of it, which was published in the year following, the Commission observes:—"The great importance of chronometers, or marine timekeepers for navigation, is universally admitted, and the use of these has accordingly become more and more extensive, even in mercantile ships. Also, for determining longitude on shore, and for several scientific purposes, the chronometer is an indispensable instrument. It is, therefore, a very satisfactory circumstance that we possess two establishments for chronometer making, viz., that of Urban Jürgensen's Sons at Copenhagen, and that of Kessel's at Altona. In these, chronometers are made which in every respect may vie with the best English and French, which has been proved by several trials, chiefly made by Professor Schumacher; but the Commission greatly regret that no chronometers of Kessel's have been sent to the Exhibition.

"The chronometer and watch establishment of Urban Jürgensen's Sons must, for the aforementioned reasons, and also, because it sent the greatest number and variety of watches to the Exhibition, be an object of particular attention; and we may refer those who feel an interest in this establishment, to the specification of chronometers, thermometers, watches, &c., made by Urban Jürgensen's Sons, which has been published by Mr. L. U. Jürgensen, in 1837. The prices are scarcely so high as those of similar chronometers from the English and French establishments.

"From the youngest son, Jules Jürgensen, who at present sojourns in Switzerland, a chronometer of an entirely new construction, invented by the exhibitor himself, was here to be seen. The chief problem which the inventor had proposed to solve, was to construct a chronometer in form and size equal to a small ordinary pocket watch—the diameter was 21 lines, and the thickness 3 lines—and in point of accuracy, should be equal to ordinary chronometers, which are not well fitted for carrying about. This chronometer is a satisfactory proof, as well of an uncommon reflection and inventive genius, as also of a great dexterity in the execution of the manual labour in the art of watch making, so that it, in both respects, is very creditable to the exhibitor.

"In the establishment of Urban Jürgensen's Sons, several other kinds of watches and instruments for scientific use are made besides the chronometers, such as astronomical pendulum clocks, watches of special construction adapted for observations, showing sidereal time and meantime, metal thermometers, &c., &c. Of watches, destined for common use, there are made in this establishment fancy or gentleman's chronometers, half-chronometers, and different kinds of tastefully-constructed pocket watches; besides these, watches, which are roughly manufactured in Switzerland according to drafts, are here examined and finished, whereby the work becomes far more accurate than even the better kind of manufactory watches, and yet they are sold at prices which, considering the perfection of the article, are moderate.

"The metal thermometers exhibited by Urban

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Jürgensen's Sons may also be referred to the trade of watch making. This kind of thermometer their father invented in the year 1805, and was honoured for the same by the Royal Society of Rural Economy with their largest gold medal, as for one of the most ingenious inventions, as well as most interesting for the physical sciences ever exhibited to the society. These thermometers have this advantage over the quicksilver thermometers, that they are more easily carried from one place to another, and they also show the lower degrees of temperature at which the quicksilver freezes.

"One of those that were exhibited was provided with a contrivance by Louis Urban Jurgensen, and had two hands, which show the highest or the lowest degree of temperature for a definite space of time; and to this improvement another is added, viz., that the enamelled dial-plate is broken through in the middle, so that the heat and cold acts with greater speed upon the thermometer, which consequently also sooner shows the change of temperature.

The Commission, in consideration of the above facts, awarded to Messrs. Jürgensen a first class gold medal.

MACHINE FILE-CUTTING.

"Some few weeks ago we announced that a company had been formed for the purpose of making files by machinery; and that, owing to the refusal of the trades' unions of Sheffield—the seat of the file manufacture—to have machinery there, the first works of the new company were to be erected in Birmingham. We further stated that while the patents of Mr. Greenwood, of Leeds, were to be brought into requisition for the making of files in blank, that of M. Bernot, which has been in use some time both in France and Belgium, was to be used for the cutting—the most important, and hitherto the most difficult branch of the manufacture. The value of M. Bernot's patent file-cutting machine, we remarked, consisted in this:—That while it would do the work of six or seven men, it only required a comparatively unskilled workman to manage it, whereas the hand file-cutter is a highly skilled workman, commanding a proportionately high rate of wages. It was also hinted that the files cut by this machine were superior in quality to those cut by hand, but this is a question which practical men would no doubt like to decide for themselves. They have now the opportunity. Since we last wrote on this subject, Mr. Allinson, who was engaged by the promoters of the company to report on the manufacture, has brought one of M. Bernot's machines—that shown at the Exhibition of 1862—down to Birmingham, and, by the permission of Messrs. W. May and Co., has put it up in their works in Tennant Street. The machine, which is very compact, resembles a steam hammer in its general appearance, and the principal features which give it value, may be shortly summed up as follows:—It is provided with a vertical slide carrying a chisel on the lower end. The top of this slide is pressed by a flat spring, which is governed by a cam mounted upon a shaft, and actuated by a ratchet wheel and 'paul,' and thus the strength of the blow of the chisel is regulated to the varying breadth of the file.

"A projection at the other end of the slide comes in contact with a cam upon the driving shaft of the machine, and so sets the machine in motion. The blank to be cut is placed upon a travelling slide, which rests upon a semi-circular bed, which is mounted in trunnions, resting in swivelling journals, so that the surface of the blank can be presented at the desired angle to the chisel. The blank is held parallel to the edge of the chisel by means of a weighted 'leveller.' All being ready, the file is fixed in the bed, the machine is set in motion, there is a terrible clatter for a moment or two, and the file runs out, cut, ready, after being hardened, for use. The rate at which the chisel goes may be judged from the fact, that it makes from 800 to 1500 cuts per minute, and will produce about five or six times the amount of work which can be supplied by hand-cutting. It can cut files of every shape and description that can be cut by hand, and the work is produced with mathematical accuracy. The teeth raised are equidistant one from another, and of that uniform depth and sharpness that forms one of the chief constituents of a good file. This regularity gives evenness, and causes each tooth, when the file is brought into use, to do its proportionate share of the work, effecting thereby a more rapid

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reduction of the metal acted upon. The teeth, it is said, are not so liable to be broken out, as in hand-made files, where they project one beyond the other, and for which reason the machine-cut files are found to be more durable. Rasps can also be cut by a suitable adaptation of the machine. This cutting machine has been in practical operation for several years at Douai, in France, and also in Belgium, where, we understand, the superior quality of the files has obtained preference in the arsenals, railways, and machinists' shops of both countries. They have also, we believe, been subjected in this country to severe trials, and have been found of excellent quality. 'The experience at Douai of the cost of working the machines is,' says Mr. Allinson, 'that two skilled mechanics will keep sixty cutting machines in thorough order; and that two persons, properly acquainted with the work, will make, repair, grind, and whet all the chisels required in working that number of machines. The cost of zinc for file beds is equal to about threepence per machine per day—the cost of steel for chisels may be assumed, at the outside, at sixpence per machine per day. It is found at Douai, that chisels for machine cutting last much longer than for hand, and will effectually cut more files without being reground.

"'This arises from the fine edge of the chisel being rubbed a short distance along the surface of the blank, to guide the hand-cutter; whereas, in machine cutting, the chisel is drawn out of the cut without abrasion. The consumption of oil and other small stores are estimated to be the same per machine, as in machinists' shops. The machines employed at Douai are of three sizes, but the experience they have now had shows that the variety of sizes may be beneficially increased. To obtain the advantage of organization arising from a careful division of labour, file manufacturing should be on such a scale as would permit one description and size of work to be confined to one machine and one man, whose constant practice in this one operation, would produce a file of a quality superior to anything under the present system of manufacture; and at the same time at a fraction of the cost.'

"From this it will be seen that Mr. Allinson contemplates carrying out the manufacture on the factory system.

"Mr. Allinson goes on to show the commercial advantages of the machine over manual labour:—'A machine,' he says, 'to cut fourteen-inch hand-bastard files, makes 1,000 cuts per minute, or 600,000 cuts per day. A good file-cutter, upon the same size and description, makes 140 cuts per minute, or 84,000 per day.

"'The machine works as rapidly and perfectly at the end, as at the beginning of the day. The man's ability to sustain his rate, along with good work, is materially affected by fatigue and the relaxation of the muscles, consequent on such heavy and continous labour. At Douai, the machine cut twelve dozen of such files per day. A man cannot cut by hand more than two dozen per day, and maintain this average rate for a week. The wages for the week's work of hand-cutting would be forty-four shillings. The cost of labour and superintendence of the machines would be less than this; but assuming it to be the same, the following is the result of a comparison of the two:—By hand, twelve dozen of files are cut, at a cost in labour of forty-four shillings. By machine, seventy-two dozen, or six times the quantity, at a similar cost in labour of forty-four shillings. The machine possesses advantages in producing fine cut files, even more considerable than shown by the coarse cut just mentioned.' The basis upon which these calculations are made, seem to be the actual results at Douai, and the price lists of the File-Cutters' Union at Sheffield. In ascertaining the cost of making by hand, however, a discount, varying from 12½ to 20 per cent., is taken off the list price, as allowances are now made therefrom, in exceptional cases, to such makers of common files as are willing to employ inferior hands, and a liberal rate of wages is charged for working the machines. The actual results of the working of the machine now in Birmingham, seem to be these—the youth of whom we have spoken receives sixteen shillings per week, and can cut twelve dozen files per day; the machine, however, running at only 600 or 700 cuts per minute. A hand file-cutter could not cut these same twelve dozen files in less than a week, and would receive from forty to forty-five shillings for doing it. The youth, receiving two shillings and eightpence per day, therefore, does the work for which the man would receive from forty to forty-five shillings.

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The whole cost of the machine, for the day's work, is three shillings and fourpence."—*Birmingham Daily Post.*

AWARDS OF THE INTERNATIONAL EXHIBITION, 1862.

It may not be generally known that a meeting of gentlemen to whom Medals and certificates of Honourable Mention were awarded by the Commissioners of the Exhibition of 1862, was held at the rooms of the Society of Arts, on the 18th of June last. It is most probable that the meeting was chiefly composed of members of the Society, and their immediate friends. However that may be, a committee was appointed for the purpose of obtaining protection for the prize medallists, against the unauthorized assumption of the Medals and Honourable Mentions, by persons to whom they had not been granted. A copy of the report of this committee has been forwarded to us, from which we extract the following particulars:—

"The meeting was called, in consequence of a recent case, in which an application was made to the Court of Chancery for an injunction to restrain the piracy of the prize medals, by a manufacturer who had not obtained any prize medal, nor exhibited at the Exhibition, but which application had failed: the Vice Chancellor having decided that in the existing law, the granting a prize medal to one manufacturer or exhibitor, creates no right on his part to restrain any statement (fraudulent or otherwise) by another manufacturer of a similar article to the effect that *he* had obtained a medal."

The Committee, after consideration, obtained professional assistance, and prepared a Bill, which was laid before the President of the Board of Trade, who declined to introduce such a measure to the House of Commons at so late a period of the session. Application was then made to Earl Granville, but, after some discussion, the required aid was not obtained in that quarter. The result was, that a short Government Bill was prepared in place of that proposed by the Committee, who made in the proper form various suggestions, some of which were adopted, "as respects others, your Committee were less fortunate."

This Bill was introduced into Parliament, passed the required forms, received the Royal assent, and became law in six days; a rate of speed which certainly did not obtain in the proceedings of the Commissioners of the "International Exhibition of 1862."

After some laudatory remarks on the agencies employed in this rapid legislation the report goes on to say that, "It cannot but be felt, that every medal holder will derive benefit from the act that has been obtained, and that the commercial value of the awards of the Commissioners of the Exhibitions of 1851 and 1862, both at home and abroad, has been greatly enhanced by the legislative protection secured."

After stating that the Committee will continue to watch the working of the act, the report concludes with an appeal to persons interested, for contributions towards the expenses incurred.

The following is a copy of the act:—

COPY OF THE EXHIBITION MEDALS ACT, 1863.

"WHEREAS it is expedient to prevent false representations with respect to grants of medals and certificates by the Commissioners for the Exhibition of 1851, and the Commissioners for the Exhibition of 1862: be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the lords spiritual and temporal, and commons, in this present parliament assembled, and by the authority of the same, as follows:—

"I. If any Trader commits any of the offences following; that is to say:—

"1. Falsely represents that he has obtained a medal or certificate from the Exhibition Commissioners in respect of any article or process for which a medal or certificate has been awarded by the Commissioners;

"2. Falsely represents (knowing such representation to be false) that any other trader has obtained a medal or certificate from the Exhibition Commissioners;

"3. Falsely represents (knowing such representation to be false) that any article sold or exposed for sale has been made by, or by any process invented by, a person who has obtained in respect of such article or process a medal or certificate from the Exhibition Commissioners;

"He shall incur the following penalties: that is to say,

"1. For the first offence he shall forfeit to Her Majesty a sum not exceeding Five Pounds.

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"2. For any subsequent offence he shall forfeit to Her Majesty a sum not exceeding Twenty Pounds, or be imprisoned for a period not exceeding six months.

"II. In proceedings under this act it shall not be necessary to prove that any person has sustained damage by the false representations of the defendant.

"It shall not be necessary in any proceedings under this act to set out any copy or fac-simile of any medal or certificate.

"III. For the purposes of this act, 'The Exhibition Commissioners' shall mean the Commissioners for the Exhibition of 1851 and the Commissioners for the Exhibition of 1862.

"The term 'Defendant' shall mean any person against whom proceedings may be taken under this act.

"IV. Offences under this act may be prosecuted summarily in England and Ireland before two justices; as to England, in manner directed by an act passed in the session holden in the eleventh and twelfth years of the reign of Her Majesty Queen Victoria, chapter forty-three, intituled 'An Act to facilitate the performance of the duties of justices of the peace out of sessions within England and Wales, with respect to summary convictions and orders,' or any act amending the same; as to Ireland, in manner directed by the act passed in the session holden in the fourteenth and fifteenth years of the reign of Her Majesty Queen Victoria, intituled 'an act to consolidate and amend the acts regulating the proceedings in petty sessions, and the duties of justices of the peace out of quarter sessions in Ireland,' or any act amending the same.

"In Scotland, an offence against this act may be prosecuted summarily at the instance of the procurator fiscal, before any sheriff or sheriff substitute, or before any two justices of the county, or before the magistrates or any police magistrate of the burgh in which the offence was committed.

"V. No provision of this act shall take away, diminish, or prejudicially affect any suit, process, proceeding, right, or remedy which any person may be entitled to at law, in equity, or otherwise; nor exempt nor excuse any person from answering or making discovery upon examination as a witness or upon interrogatories or otherwise, in any suit or other civil proceeding: provided always, that no evidence, statement, or discovery, which any person shall be compelled to give or make shall be admissible in evidence against such person in support of any indictment for a misdemeanor at common law or otherwise, or of any proceeding under the provisions of this act.

"VI. This act may be cited for all purposes as 'The Exhibition Medals Act, 1863.'"

Plumbago has recently been introduced as the basis of a superior cement for steam joints, and the general metallic connections of the engineer. It is composed of 6 parts of plumbago, 3 of slacked lime, 8 of sulphate of baryta, and 3 of boiled linseed oil. This compound, it is said, secures a perfectly air and steam-tight joint, much superior to that obtained by the use of red lead.—*Mechanics' Magazine.*

METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., August, 1863.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	Inches.	°	°	°	°				
1	30·154	63	57	69	50	E	3	o	o, cb, p
2	·020	67	61	72	55	ESE	3	c	cb
3	·060	67	62	80	56	SW	3	c	p, cb
4	29·948	68	63	74	56	SW	6	c	o, r
5	·892	61	57	72	57	Calm	0	o	p, cb, r
6	·936	63	60	73	57	SW	5	r	o
7	30·055	67	64	69	60	WSW	3	o	p, bc, r
8	·155	70	65	80	62	WSW	2	o	bc
9	·155	67	64	79	59	SW	3	o	bc
10	·125	67	62	82	60	W	2	o	bc
11	·020	65	59	78	61	W	2	cb	bc
12	·113	63	57	74	52	NE	2	cb	cb
13	29·941	66	61	72	55	SE	4	c	bc
14	30·076	66	60	77	60	ESE	4	o	cb
15	29·841	68	63	75	58	SSW	4	o	cb, b
16	·866	68	62	78	62	SSW	3	bc	bc, mb
17	·734	61·5	56·5	74	58	WNW	3	o	cb, p, b
18	·803	58	54	69	50	NNW	4	bc	cb, b, p
19	·941	55	52	63	52	WNW	2	o	opm
20	·967	57	53·7	62	50	NNW	4	cb	p,o,m,b
21	30·190	55	51	62	48	NNW	4	bc	o
22	·116	57·7	55	65	53	NW	1	po	c, m
23	29·980	63·5	59	68	57	SW	2	pc	bc, cm
24	·903	61	58	71	59	W	3	cb	cb, bm
25	·720	61·5	56·5	70	52	SSW	2	o	cb,pplt,b
26	·554	59	54·5	68	51	SSW	1	c	rr
27	·406	59	57	62	56	SSE	3	c	p,c,r,b
28	·684	60·5	57	68	54	SSW	2	c	cb, rllt
29	·736	60·5	56	70	55	S	2	bc	cb, b
30	·906	60·5	57·5	68	53	WNW	2	bc	bc
31	·708	59·5	56	69	57	S	7	or	c. p,bc
	29·926	62·7	58·5	71·4	55·6		3	Mean.	

Remarks.

The greatest atmospheric pressure was 30·20 at 8 a.m., 21st, and the least 29·39 at 8 a.m., 27th; hence the range was 0·81 of an inch.

According to the 9 a.m. observation, W winds prevailed on 12 days, S on 10, E on 4, N on 4, and the air was calm once.

The rain amounted to 1·77 inches, having fallen on 17 days, during about 40 hours.

On the 25th two thunderstorms occurred, about 4 and 6 p.m., each lasting half an hour; during the first 0·24 inch of rain fell; during the second 0·17.

On the 28th, from 10 p.m. to midnight, there was much lightning, with distant thunder, and 0·19 inch of rain.

The atmospheric pressure and temperature, also the mean range of both barometer and thermometer, were almost identical with the averages for August. The winds were most frequent from the south of west. The weather was remarkably hot on the 2nd, 7th, and 9th; and very cold, by contrast, on the 20th. Rain fell on the average number of days, but was 0·7 of an inch below the mean amount.

The weather was very fine and favourable for an early harvest.

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EQUATION OF TIME TABLE
For October, 1863.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *added* to Mean Time.
		m. s.	s.	m. s.
Thurs .	1	10 13·56	0·801	10 13·70
Fri . . .	2	10 32·63	0·788	10 32·77
Sat . . .	3	10 51·39	0·774	10 51·53
Sun. . .	4	11 9·81	0·759	11 9·95
Mon . .	5	11 27·87	0·744	11 28·01
Tues . .	6	11 45·55	0·728	11 45·69
Wed . .	7	12 2·83	0·711	12 2·97
Thurs .	8	12 19·68	0·693	12 19·82
Fri . . .	9	12 36·09	0·674	12 36·23
Sat . . .	10	12 52·04	0·655	12 52·18
Sun. . .	11	13 7·52	0·635	13 7·66
Mon . .	12	13 22·50	0·614	13 22·64
Tues . .	13	13 36·99	0·593	13 37·13
Wed . .	14	13 50·97	0·571	13 51·10
Thurs .	15	14 4·41	0·549	14 4·54
Fri . . .	16	14 17·30	0·526	14 17·42
Sat . . .	17	14 29·63	0·502	14 29·76
Sun. . .	18	14 41·39	0·478	14 41·51
Mon . .	19	14 52·56	0·453	14 52·67
Tues . .	20	15 3·12	0·427	15 3.23
Wed . .	21	15 13·07	0·401	15 13·18
Thurs .	22	15 22·38	0·374	15 22·48
Fri . . .	23	15 31·04	0·346	15 31·13
Sat . . .	24	15 39·02	0·318	15 39·10
Sun. . .	25	15 46·30	0·289	15 46·37
Mon . .	26	15 52·89	0·259	15 52·96
Tues . .	27	15 58·74	0·228	15 58·80
Wed . .	28	16 3·85	0·197	16 3·90
Thurs .	29	16 8·20	0·165	16 8·25
Fri . . .	30	16 11·77	0·133	16 11·81
Sat . . .	31	16 14·57	0·100	16 14·60

PROVISIONAL PROTECTIONS.

INVENTIONS RELATING TO HOROLOGY.

Commencing January, 1863.

Dated May 6th, 1863.

1131. S. D. MAC KELLEN, Manchester, watch-manufacturer.—Certain improvements in watches and other timekeepers.

Dated May 9th, 1863.

1172. J. BURRELL, 85, Back Church-lane, Whitechapel.—Improvements in machinery for cutting the teeth of bevelled wheels.

Dated May 28th, 1863.

1339. C. E. LAEDERICH, Paris, gentleman.—Improvements in watches.

Dated June 3rd, 1863.

1391. J. PORTLOCK, Hampstead-road, gunmaker.—An improved alarum apparatus.

Dated June 20th, 1863.

1554. A. T. N. GOLL, Caledonian-road, jeweller.—Improvements in the manufacture of mountings or settings for precious or other stones.

Dated June 24th, 1863.

1595. T. SKINNER, Sheffield, electroplater and engraver.—Improvements in the ornamentation of silver, German silver, Britannia metal, electro-plated, or other plated goods.

Dated June 30th, 1863.

1631. S. COLE, Moseley, Worcester, manufacturer.—Improvements in clasps or fastenings for securing brooches, solitaires, and other dress ornaments.

Dated July 21st, 1863.

1828. R. A. BROOMAN, 166, Fleet-street. Patent agent.—Improvements in watches and other timekeepers. (A communication.)

Dated July 9th, 1863.

1717. G. GOWLAND, Liverpool, chronometer maker.—Improvements in the construction and arrangement of nautical and surveying instruments for measuring angles and altitudes.

Dated July 14th, 1863.

1767. E. FUNNELL, Brighton, watch and clock-maker.—A self-acting electro-magnetic clockwork signal for railway purposes.

All Communications for this Journal should be addressed to the EDITOR, *at the Office*, 35, Northampton Square, Clerkenwell.

Our pages are at all times open to correspondence and contributions, either original or compiled from good authorities.

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STANDARD MEASURES.

The Times of September 15th, in an article on the Metrical and Decimal Systems, contains the following account of the steps taken to determine the standard measure—The Metre.

When men became convinced that the surface of the earth was curved, they jumped to the conclusion that it was a sphere, and this was the universal belief until the days of Huygens and Newton. On the occasion of the disputes relative to Newton's theory of the flattening of the globe, Colbert gave orders to have the Paris meridian measured through France. The operation was commenced in 1685 and terminated in 1718, under the direction of the younger Cassini, whose son, in company with Lacaille, in 1739-40, measured the meridian from Dunkirk to Perpignan. In 1737, Bouguer and Lacondamine measured degrees of meridian in Peru—as did Maupertuis in Lapland—and demonstrated the flatness of the earth at the poles.

It will be remarked that the original idea of the Assemblée was to adopt the English standard, by taking for base the length of the pendulum vibrating seconds in 45 deg. latitude, and that taking a fraction of the earth's meridian was not thought of. Huygens first proved that the times of vibrations of pendulums depended on their length only; and, whatever their structure, that a certain point may be found which, in pendulums that vibrate in the same time, is constantly at the same distance from the point of suspension. Hence he conceived that the pendulum might afford a standard or unit for measures of length; and, though gravitation was not the same in all latitudes, he believed science furnished the means of determining this correction with sufficient accuracy. The increase of the pendulum is more regular than that of the degrees of the meridian, and differs less from the proportion of the squares of the sines to the height of the pole, either because its measurement is easier than that of the degrees, is less liable to error, or because the perturbating causes of the regularity of the earth produce less effect upon gravitation.

Richer, who was sent in 1672, by the Academy to make astronomical observations at Cayenne, remarked that his time-piece, which had been regulated at Paris, mean time, lost regularly at Cayenne; and he was thereby enabled to obtain the first direct proof of the diminution of gravitation at the equator. Fresh operations were made at the equator and in Lapland, and more especially by Borda in the Paris Observatory, and by Biot, Arago, and Mathieu, at Formentera, Bordeaux, and Dunkirk, which established the now well-known fact—the regular increase of the lengths of the pendulum going from the equator to the poles. M. le Marquis de Laplace, after alluding in his *Exposition du système du Monde* to this discovery, says,—"The observations of the pendulum, by furnishing a length invariable and easy to be found at all times, has suggested the idea of employing it as a universal measure." The length of the pendulum and that of the meridian are the two chief means to be found in nature for determining the unit of lineal measure. The French chose the meridian; our predecessors preferred the pendulum. The reason for the preference given by the French is set forth in a report to the Academy from Condorcet, Borda, Lagrange, Laplace, and Monge, dated the 19th of March, 1791. There were three different fundamental units to select from, they say—a quadrant of the equator, or a quadrant of the meridian, or the length of the pendulum marking seconds. The Commissioners reported that if the length of pendulum were employed to furnish the standard, as proposed in the address to George III., the degree of latitude should be the 45th, because it is the arithmetical mean between all pendulums unequal, one to another, beating seconds in different latitudes. But they objected that the pendulum standard contained an heterogeneous element—time and an arbitrary element—the division of the day into 86,400 seconds, while they deemed it was possible to have a unit of length taken upon the earth itself, which would depend upon no other quantity. The Commissioners believed it much more natural to compare the distance between two places with one of the terrestrial circles than with the length of the pendulum. As for the quadrant of the equator, they observed that its regularity

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was not more certain than the regularity or similarity of the meridians; that the celestial arc corresponding to the space measured is less capable of being determined with precision; and that every nation lays claim to an arc of the meridian, while but very few are placed under the equator. Consequently, there remained the quadrant of the terrestrial meridian only. The Commissioners recommended that it should be immediately measured, and its ten-millionth part adopted as the unit of lineal measurement; that the meridian should be divided decimally into degrees, minutes, and seconds; and that the base for weights and measures of capacity should be distilled water, weighed *in vacuo* at the temperature of melting ice. The arc to be measured should be that of the meridian passing from Dunkirk to Barcelona, which is rather more than 9½ deg., is 6 deg. to the north, and 3½ deg. to the south of mean parallel, and has its extreme points at the level of the sea. Already Lacaille had measured a degree at the Cape, and Boscovich the distance from Rome to Rimini. In 1762, Beccaria measured a degree in Piedmont, Liesganig commenced to measure three degrees in Austria, a fourth in Hungary, and six years later Mason and Dixon measured two degrees in the plains of Pennsylvania.

Circulars were sent from Paris to foreign States, inviting to take part and to send *savans* to form a commission with members of the Institute. The commission was subsequently formed, and consisted of Ænea (Holland), Balbo (Sardinia), afterwards replaced by Vassalli, Berthollet (as member of the Egyptian Institute), Borda, Delambre, Méchain, Bresson, Buggé (Denmark), Ciscar (Spain), Darcet, Coulomb, Fabbrione (Tuscany), Franchini (Rome), Haüy, Lagrange, Laplace (president), Legendre, Mascheroni (Cisalpine Republic), Lefèvre-Gineau, Mongés (as member of the Egyptian Institute), Mulledo (Portugal), Pedrones (Spain), Prony, Tralles (Swiss), Vendermonde, and Van Swinden (Holland), who took as active and important a part as any.

It would be tedious to follow the progress of the work and describe in detail the labours, sufferings, and scientific blunders of the Commissioners. But it may be briefly stated, the ten millionth part of the meridian measured in Peru toises* $\frac{5,130,740}{10,000,000}$, was adopted as a standard and base for the new French weights and measures, and called a metre. It was equal to 443·295936 lines of the Paris foot; but its legal value and standard were established by law 10th Dec., 1799, at 443·296, thus suppressing three places of decimals. Since the adoption of the metric system several subsequent admeasurements have proved that its base, or the metre, is incorrect. The real length of the quadrant of the meridian is 5,131,800, not 5,130,740 toises, and therefore 1,060 toises more than the French *savans* calculated it at. Consequently, the true length of the metre is 443·39 lines—not 443·296 lines—and about one-tenth of a line longer than it is fixed at by law. The commission committed two mistakes—one in the reduction of the bases, and the other in comparing the platina rules,—standards of the metre,—with the toise. The errors were afterwards nearly compensated. Further, and in spite of the advice of Delambre, they omitted to recalculate the arc of the Peru meridian, in which Delambre subsequently made a correction of 16 toises by degree. "Lastly," says M. Saigey,—

"If even the operations had been made with mathematical precision, there would always remain the uncertainty of the deviation of the verticals due to the attraction of continents on plumb lines. Wherefore the Commissioners greatly deceived themselves when they defined the length of the metre by means of six decimals. Delambre alone saw, in all probability, this species of ridiculousness, and *niaiserie de geomètre*, when he endeavoured to have the length of the metre fixed at 443·3 lines."

Delambre did his utmost to extenuate the errors of the Metrical Commission, and the writer just quoted pointedly observes, that it was singular to behold the *savant* charged with editing the descriptions of the works executed for the metric system, correct results reputed irrevocable, and substitute other numbers for those which ought for ever to represent the dimensions of our globe. Delambre declared that if the standard were allowed to remain as it then was, it would be necessary to measure it, not at the temperature of melting ice—the centigrade zero—as legally must be done, but at a much higher temperature, which he proposed should be 8·5 degrees centigrade.

* Toise, a measure of 6 French feet.

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TITANIFEROUS IRON ORE.

The reduction of the titaniferous iron ores found in the form of sand on the shores of the Black Sea, the Bay of Naples, and also along the shores of New Plymouth, in New Zealand, has lately engaged the attention of practical metallurgists to a considerable extent. Several companies have been formed in the City with a view of working these deposits with profit; and considerable sums of money have been spent in experiments conducted with a view of arriving at some means of converting this rich and valuable ore on a large scale.

We have examined different specimens of this peculiar metallic sand from the shores of New Zealand; from Poti, in Asia Minor; and from Naples. They have all a similar appearance, that of fine steel-filings, and they are strongly attracted by a magnet. The Italian specimen is somewhat mingled with common sea-sand, or silica.

The great value of these ores is due to their large per centage of iron, to their freedom from sulphur, phosphorus, &c., and to the presence of titanium itself in the form of an oxide.

There is little doubt that steel is considerably improved by a mixture with titanium; and it is not improbable that the presence of this metal would also raise the quality of cast-iron. The wonderful temper and tenacity of the sword-blades of the Japanese are said to be partly due to the presence of titanium in the steel of which they are manufactured.

It is stated by recent travellers in Japan, that all the iron of that country is made from this peculiar sand. The sword-blades used by the Circassians are also made from the titaniferous iron ores of the country, and according to well-authenticated accounts, their temper and durability is something marvellous. Of course, the mere presence of titanium does not wholly account for excellent quality of the iron manufactured by these semi-barbarous nations; the ore itself is pure, and it is always smelted with charcoal.

The most common mineral containing titanium is this titaniferous peroxide of iron. It is very similar in appearance to the magnetic oxide of iron, and it is, indeed, often mistaken for the latter mineral. Titaniferous iron ore is found in small quantities in Cornwall. Its scarcity has prevented its adoption, up to the present, in practical metallurgy; and this is also the reason that the metal titanium has been only discovered within a recent period.

The titaniferous oxide of iron, of the secondary formations, has always the appearance of black grained sand, the particles of which are attracted by the magnet. For a long time the titanium was only known in the form of an oxide. It has been found united with nitrogen and carbon in the slag from the blast furnaces of the Merthyr Tydvil iron works, in the form of well defined prismatic crystals of a copper colour. The various titaniferous iron ores contain from 13 to 52 per cent. of oxide of titanium in union with oxide of iron. Metallic titanium is somewhat similar in appearance to brass. Up to the present, the principal application of titanium has been in the form of titanic acid for painting porcelain. It is used to produce a pale yellow colour.

It will be at once seen that the great obstacle to the reduction of these peculiar ores, on a large scale, consists in their being generally found in a state of minute subdivision. It would be impossible to feed a blast furnace with such a material. Although a large amount of capital has been spent in experiments, we believe that up to the time we write, no ready means have been found to make the sand cohere in masses large enough for the free passage of the blast. The experiments have been conducted by several eminent metallurgists, but the investigations have been necessarily secret. It is not improbable that bricks of the necessary tenacity might be formed of this material by the use of a "high-pressure" brick-making machine. A process of baking, with an appropriate flux, might also arrive at a similar result. Mr. Mushet has made some first-class steel from this ore; but the process was carried out in crucibles, with their attendant expense. The steel was shown in the Sheffield Court and in the New Zealand Court of the late Exhibition.

Should the hopes prove well-founded, that an admixture of this ore with our English makes of iron would improve the quality of the product, this fine sand could be injected through the trujeres into the furnace by means of the blast.

This process has been already carried out with powdered charcoal, and also with pulverized calcined iron ore. It is evident that the attainment of a profitable means of reducing this rich and pure ore is merely a question of time and well-directed capital. It may buoy up the hopes of those who have spent large sums in, as yet, unfruitful experiments, to remember that the ordinary process of manufacturing—flowing on with the ease due to long practice and experience—have themselves been evolved from a costly process of trial and error.—*Mechanics' Magazine.*

Mr. M. ASSMAN, a Prussian-Polish Jew, resident in Fawcett Street, Sunderland, has invented a clock which keeps time on what he claims to be a new principle of metallic motive power. The clock has neither weights, chains, springs, nor pendulum, and keeps time without the slightest noise or ticking. The principle of the clock is so simple, that it will need little or no regulating or repairs, and the inventor believes it will surpass in time-keeping the most correct watches and chronometers now in use. Mr. Assman intends shortly to exhibit his clock.—*Mechanics' Magazine.* [May we be there to see!!] ED. H. J.

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NAME OF MAKER.	No.	Whether Pocket, 2, or 8 Days.	ADDRESS OF MAKER.	Construction of Escapement and Balance, from the Description furnished by the Maker.
J. B. Fletcher . .	2690	2	148, Leadenhall street, London	Auxiliary compensation.
Kullberg	595	2	12, Cloudesley terrace, Islington, London.	Original balance, consisting of a single bar and flat rim, without auxiliary.
Webb	5447	2	4, Pullen's row, Upper street, Islington, London.	Auxiliary compensation to the bal.
Glover	315	2	4, Swinton street, Gray's inn road, London.	Auxiliary compensation, acting in cold.
Mercer	697	2	45, Spencer street, Goswell road, London.	Original auxiliary compensation.
Cribb	728	2	30, Southampton row, Russell square, London.	Auxiliary compensation to the bal.
Reid and Sons . .	1220	2	41, Grey st., Newcastle-upon-Tyne	Auxiliary to the balance.
Gowland	2669	2	Sunderland.	Auxiliary compensation.
Poole	3343	2	57, Fenchurch street, London.	Poole's auxiliary.
Reid and Sons . .	1228	2	41, Grey st., Newcastle-upon-Tyne	Auxiliary to the balance.
Kullberg	596	2	12, Cloudesley terrace, Islington, London.	Original balance, consisting of a bar and two rims, without auxiliary.
C. Frodsham . . .	3155	2	84, Strand, London.	Ordinary compensation, with an experimental auxiliary for high temperatures.
C.M. Frodsham, jun	$\frac{4}{8148}$	2	84, Strand, London.	New construction of balance.
P. Birchall . . .	841	2	65, Great Percy street, London.	Ordinary construction of balance, with a slight alteration.
J. J. Muirhead . .	7279	2	Buchanan street, Glasgow.	Auxiliary compensation to the bal.
Millidge and Son .	382	2	28, Princes street, Edinburgh.	Original auxiliary compensation.
McGregor and Co. .	3324	2	38, Clyde place, Glasgow, and 8, William street, Greenock.	Poole's auxiliary.
Brunton	555	2	3, America square, John street, Minories, London.	Auxiliary to balance.
Hennessy	3265	2	5, Wind street, Swansea.	Poole's auxiliary.
T. Campbell . . .	904	2	7, South Castle street, Liverpool.	Ordinary construction of balance, with a slight alteration.
J. Campbell . . .	911	2	7, South Castle street, Liverpool.	Ordinary construction of balance, with a slight alteration.
J. Fletcher . . .	2933	2	148, Leadenhall street, London.	Auxiliary compensation.
Chittenden . . .	670	2	20, Kent villas, Grange road east, Dalston, London.	Ordinary construction.
Roskell.	$\frac{1761}{8824}$	2	21 & 23, Church street, Liverpool	Hartnup's balance.
Lister and Sons. .	592	2	Newcastle-upon-Tyne.	Poole's auxiliary.
C.M. Frodsham, jun	$\frac{5}{8808}$	2	84, Strand, London.	New construction of balance.
Moore	3363	2	114, High street, Belfast.	Poole's auxiliary.
J. Fletcher . . .	2818	2	148, Leadenhall street, London.	Auxiliary compensation.
Dent	3019	2	61, Strand, London.	Dent's patent balance; see pamphlet "On the Errors of Chronometers," p. 23.

* During these weeks the North windows of the Chronometer Room were left open.

† During these weeks the Chronometers were placed in the chamber of a stove heated by gas.

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(III.)—ABSTRACT OF THE PRINCIPAL CHANGES OF RATE.

First Day of First week of Rating.	Last Day of Last Week of Rating.	No. of Weeks.	Least Weekly Sum.	In what Week.	Greatest Weekly Sum.	In what Week.	Difference between the Greatest and Least.	Greatest Difference between one Week and the next.	Before and after what Day.
			s		s		s	s	
Jan. 10	July 18	27	−12·4	February 14 to 21*	− 5·6	June 6 to 13†	6·8	3·6	† Feb. 28†
Jan. 10	July 18	27	− 8·5	July 11 to 18	+ 2·5	January 17 to 24*	11·0	4·1	Mar. 21
Jan. 10	July 18	27	− 6·9	February 21 to 28†	+ 2·1	May 16 to 23	9·0	5·5	† May 30†
Jan. 10	July 18	27	− 1·4	Jan. 31 to Feb. 7*	+11·3	July 11 to 18	12·7	6·4	* Feb. 21†
Jan. 10	July 18	27	−12·6	February 21 to 28†	+ 0·2	May 9 to 16	12·8	6·5	May 23†
Jan. 10	July 18	27	−10·3	February 21 to 28†	+ 2·5	June 13 to 20†	12·8	6·7	† June 20
Jan. 10	July 18	27	− 3·1	February 21 to 28†	+ 7·4	April 4 to 11	10·5	8·3	* Feb. 21†
Jan. 10	July 18	27	− 1·8	January 10 to 17*	+13·2	March 7 to 14†	15·0	6·7	† Mar. 14
Jan. 10	July 18	27	− 1·1	February 21 to 28†	+18·3	July 4 to 11	19·4	5·0	† June 6†
Jan. 10	July 18	27	+ 1·7	February 7 to 14*	+16·4	July 4 to 11	14·7	7·5	† June 20
Jan. 10	July 18	27	+16·6	Jan. 31 to Feb. 7*	+31·9	June 6 to 13†	15·3	7·5	† Feb. 28†
Jan. 10	July 18	27	− 1·9	February 14 to 21*	+11·1	June 13 to 20†	13·0	9·8	† June 20
Jan. 10	July 18	27	− 3·9	Jan. 31 to Feb. 7*	+15·2	June 13 to 20†	19·1	7·0	† June 20
Jan. 10	July 18	27	− 1·2	February 21 to 28†	+13·9	Mar. 28 to April 4	15·1	9·2	* Feb. 21†
Jan. 10	July 18	27	−33·6	March 21 to 28	−17·2	March 7 to 14†	16·4	9·1	May 2
Jan. 10	July 18	27	−11·1	February 21 to 28†	+ 9·1	July 4 to 11	20·2	7·3	† June 20
Jan. 10	July 18	27	−10·6	Jan. 31 to Feb. 7*	+ 5·7	July 11 to 18	16·3	9·6	† June 20
Jan. 10	July 18	27	− 3·3	Jan. 31 to Feb. 7*	+17·5	July 11 to 18	20·8	7·6	† Mar. 14
Jan. 10	July 18	27	−13·1	Feb. 28 to Mar. 7†	+ 5·3	January 10 to 17*	18·4	8·9	* Feb. 21†
Jan. 10	July 18	27	− 1·2	February 21 to 28†	+15·0	June 13 to 20†	16·2	10·1	† June 20
Jan. 10	July 18	27	−15·4	January 10 to 17*	+ 3·4	May 16 to 23	18·8	9·0	May 23†
Jan. 10	July 18	27	− 0·6	{Mar. 28 to Ap. 4 / April 11 to 18}	+18·5	Feb. 28 to Mar. 7†	19·1	9·3	Mar. 21
Jan. 10	July 18	27	−10·3	June 13 to 20†	+ 6·1	June 27 to July 4	16·4	11·2	† June 20
Jan. 10	July 18	27	+18·1	Feb. 28 to Mar. 7†	+35·3	June 20 to 27	17·2	11·0	† June 20
Jan. 10	July 18	27	−13·5	June 13 to 20†	+ 1·4	July 11 to 18	14·9	13·8	† June 20
Jan. 10	July 18	27	+ 7·5	Jan. 31 to Feb. 7*	+31·0	{June 20 to 27 / July 4 to 11}	23·5	10·4	* Feb. 21†
Jan. 10	July 18	27	−15·5	June 13 to 20†	+ 0·8	June 27 to July 4	16·3	14·7	† June 20
Jan. 10	July 18	27	−23·2	February 21 to 28†	− 2·3	June 13 to 20†	20·9	12·5	† Mar. 14
Jan. 10	July 18	27	−12·0	February 21 to 28†	+ 8·4	March 7 to 14†	20·4	13·3	† Feb. 28†

The order of arrangement of the Chronometers in this Table is determined solely by consideration of their irregularities of rate.

The Chronometer, Cairns, 786, was found stopped on June 9, and was removed on June 15. On April 23, Blackie, 511, was also found stopped—the maker, on examination, found the stoppage to have been caused by the main spring having broken—the Chronometer was removed on April 27. The rates of these Chronometers, on account of the shorter duration of trial, are not comparable with those of the other Chronometers, and they are in consequence placed in a separate division at the end of the Table.

Two Chronometers which became deranged soon after the commencement of the trial are entirely omitted.

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NAME OF MAKER.	No.	Whether Pocket, 2, or 8 Days.	ADDRESS OF MAKER.	Construction of Escapement and Balance, from the description furnished by the Maker.
Webb	5439	2	4, Pullen's row, Upper street, Islington, London.	Auxiliary compensation to the bal.
L. U. Jürgensen. .	LXXV.	2	Copenhagen.	New escapement for diminishing friction, gold pendulum-spring, and ordinary balance.
Clark and Son . .	3135	2	Greenock.	Poole's auxiliary.
Parkinson & Frodsham.	3689	2	4, Change alley, Cornhill, London	Auxiliary to ordinary construction of balance.
Poole	3337	2	57, Fenchurch street, London.	Poole's auxiliary.
Parkinson & Bouts	1084	2	59, Gracechurch street, London.	Ordinary construction, with a slight alteration to balance.
Dent	2963	2	61, Strand, London.	Dent's patent balance; see pamphlet "On the Errors of Chronometers," p. 23.
Bennett	831	2	64 and 65, Cheapside, and 62, Cornhill, London.	New auxiliary compensation.
J. Muirhead & Son.	3337	2	Buchanan street, Glasgow.	Poole's auxiliary.
Owen Owens . . .	3120	2	4, South Castle street, Liverpool.	Poole's auxiliary.
Hennessy	3264	2	5, Wind street, Swansea.	Poole's auxiliary.
Blackie	589	2	24, Amwell street, Pentonville, London.	New supplementary auxiliary.
Reynoldson . . .	7245	2	18, Queen street, Hull.	Auxiliary compensation to the bal.
Roskell.	[illegible]	2	21 & 23, Church street, Liverpool	Molyneux's auxiliary.
F. Fletcher . . .	2913	2	148, Leadenhall street, London.	Auxiliary compensation.
Parkinson & Frodsham.	3031	2	4, Change alley, Cornhill, London	Auxiliary to ordinary construction of balance.
Hewitt and Son. .	2554	2	12, John street, Mildmay park, Kingsland, London.	Hartnup's balance.
Brunton	580	2	3, America square, John street, Minories, London.	Auxiliary to balance.
Bennett	836	8	64 and 65, Cheapside, and 62, Cornhill, London.	New auxiliary compensation.
Hewitt and Son. .	2561	2	12, John street, Mildmay park, Kingsland, London.	Original auxiliary.
Glover	343	P	4, Swinton street, Gray's inn road, London.	Auxiliary compensation acting in cold.
Eiffe	299	P	7, Orange street, Red Lion square, London.	A new unpublished principle of compensation
Birch	512	2	173, Fenchurch street, London	Auxiliary compensation balance.
Gowland	2664	2	Sunderland.	Auxiliary compensation.
Parkinson & Bouts.	648	2	59, Gracechurch street, London.	Auxiliary to balance.
Highfield, Brothers	5845	2	5, King Edward terrace, Liverpool road, Islington, London.	Auxiliary to balance.
Cairns	786	2	13, Waterloo road, Liverpool	Poole's auxiliary.
Blackie	511	2	24, Amwell street, Pentonville, London.	New original auxiliary.

* During these weeks the North windows of the Chronometer Room were left open.

† During these weeks the Chronometers were placed in the chamber of a stove heated by gas.

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(III.)—ABSTRACT OF THE PRINCIPAL CHANGES OF RATE.

First Day of First Week of Rating.	Last Day of Last Week of Rating.	No. of Weeks.	Least Weekly Sum.	In what Week.	Greatest Weekly Sum.	In what Week.	Difference between the Greatest and Least.	Greatest Difference between one Week and the next.	Before and after what Day.
			s		s		s	s	
Jan. 10	July 18	27	−10·3	February 21 to 28†	+16·0	May 23 to 30†	26.3	11·3	† May 30†
Jan. 10	July 18	27	+14·0	January 10 to 17*	+39·2	April 4 to 11	25·2	12·2	* Feb. 21†
Jan. 10	July 18	27	− 1·8	June 13 to 20†	+16.0	June 27 to July 4	17·8	16·5	† June20
Jan. 10	July 18	27	−25·5	June 13 to 20†	− 4·4	February 7 to 14*	21·1	15·7	† June20
Jan. 10	July 18	27	−14·5	June 13 to 20†	+ 4·9	June 27 to July 4	19·4	16·7	† June20
Jan. 10	July 18	27	−25·7	June 13 to 20†	+ 2·7	January 17 to 24*	28·4	12·8	† June20
Jan. 10	July 18	27	−20·7	February 21 to 28†	− 0·1	{March 14 to 21 / June 27 to July 4}	20·6	17·0	May 23†
Jan. 10	July 18	27	+17·1	January 10 to 17*	+37·6	May 2 to 9	20·5	17·2	† June20
Jan. 10	July 18	27	−20·5	June 13 to 20†	+ 5·1	January 10 to 17*	25·6	16·0	May 23†
Jan. 10	July 18	27	− 9·8	July 11 to 18	+18·4	March 14 to 21	28·2	14·7	† Mar.14
Jan. 10	July 18	27	−10·0	June 13 to 20†	+17·0	March 14 to 21	27·0	15·5	† June20
Jan. 10	July 18	27	− 9·0	January 10 to 17*	+16·7	July 11 to 18	25·7	16·7	† June20
Jan. 10	July 18	27	+11·4	January 10 to 17*	+47·7	July 4 to 11	36·3	15·1	Apr. 18
Jan. 10	July 18	27	−14·2	February 21 to 28†	+14·1	June 13 to 20†	28·3	19·4	† Mar.14
Jan. 10	July 18	27	−19·0	February 21 to 28†	+ 8·9	June 6 to 13†	27·9	20·0	† June20
Jan. 10	July 18	27	− 0·5	Feb. 28 to Mar. 7†	+35·6	February 7 to 14*	36·1	21·5	* Feb. 21†
Jan. 10	July 18	27	−35·2	January 10 to 17*	− 0·7	May 23 to 30†	34·5	23·3	* Feb. 21†
Jan. 10	July 18	27	−30·1	June 13 to 20†	+ 3·8	July 11 to 18	33·9	28·4	† June20
Jan. 10	July 18	27	−11·5	January 10 to 17*	+40·3	July 11 to 18	51·8	20·8	† June20
Jan. 10	July 18	27	−11·3	June 13 to 20†	+25·7	May 9 to 16	37·0	30·1	† June20
Jan. 10	July 18	27	+ 0·4	February 21 to 28†	+75·0	July 4 to 11	74·6	15·9	July 4
Jan. 10	July 18	27	−48·2	July 11 to 18	− 9·0	June 13 to 20†	39·2	34·1	† June20
Jan. 10	July 18	27	− 2·2	January 10 to 17*	+80·4	July 11 to 18	82·6	16·9	† Mar.14
Jan. 10	July 18	27	− 8·3	February 14 to 21*	+39·7	June 6 to 13†	48·0	34·5	* Feb. 21†
Jan. 10	July 18	27	−48·4	June 13 to 20†	+ 8	April 4 to 11	57·3	36·0	† June20
Jan. 10	July 18	27	+49·5	January 10 to 17*	+123·7	June 6 to 13†	74·2	30·8	† Mar.14
Jan. 10	June 6	21	−14·3	February 21 to 28†	+ 2·3	May 16 to 23	16·6	9·7	May 23†
Jan. 10	Apr. 18	14	−19·9	{Jan. 31 to Feb. 7* / Feb. 14 to 21*}	+ 1·0	March 7 to 14†	20·9	17·9	† Mar.14

The order of arrangement of the Chronometers in this Table is determined solely by consideration of their irregularities of rate.

The Chronometer, Cairns, 786, was found stopped on June 9, and was removed on June 15. On April 23, Blackie, 511, was also found stopped: the maker on examination found the stoppage to have been caused by the main spring having broken: the Chronometer was removed on April 27. The rates of these Chronometers, on account of the shorter duration of trial, are not comparable with those of the other Chronometers, and they are in consequence placed in a separate division at the end of the Table.

Two Chronometers which became deranged soon after the commencement of the trial are entirely omitted.

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MOLECULAR CONSTITUTION OF STEEL.

Karsten observed, that by the action of acids upon soft steel, a graphitic substance is obtained as a residue, which is not obtained by the action of acids upon hardened steel. This substance he represented to be a definite carburate of iron $Fe\ C^6$. Berthier also stated that cast steel contains another carburet, C Fe.

M. Caron* infers, from the results of numerous analyses, that these carburets are probably mere variable mixtures of carbon and iron, in which the iron is protected mechanically by the carbon from the solvent action of the acid. He has experimented upon steel in three different conditions:—

1. Steel as it comes from the cementation chambers.
2. The same steel hammered for a long time.
3. The same steel hardened.

By the action of hydrochloric acid on these three kinds of steel, the quantities of graphitic residue obtained are very different, being for 100 parts as follows:—

	Graphitic residue.	Carbon.	Iron.	Silicium.
Ordinary Steel	...1·624 =	0·825	0·557	0·242
Hammered Steel	...1·243 =	0·560	0·445	0·238
Tempered Steel	...0·240 =	trace.	trace.	0·240

These results show that the effect produced by tempering is, to some extent, produced by hammering; and the quality of the steel appears to improve in proportion as the carbon is intimately combined with the iron.

In the same manner, forging, which improves the quality of steel, also reduces the quantity of carbon that is separated by solution in acids. Rolled steel gives more graphite than hammered steel. The influence of heat, in this respect, is the reverse of that produced by hammering and tempering, and re-heated steel does not recover its primitive quality, or its chemical properties, as regards acids, until after it has been hammered or tempered.

White pig iron presents the same variation in the quantity of carbon that it contains in a free state, and the duration of the annealing. However long this may last, there is still some carbon remains uncombined.†

In the tempering of steel, the rapid cooling has a compressing influence upon the metal, almost instantaneous, and presenting the closest analogy with the blow of a hammer.

A bar of steel rapidly heated to the temperature requisite for tempering, and immediately plunged into cold water, underwent the following alterations of bulk:—

	Before tempering.	Red-hot.	Tempered
Dimensions in Centimetres	20·00	20·32	19·95
	1·00	1·03	1·01
	1·00	1·03	1·01
Volume, ditto .	20·00	21·557	20·351

The effect produced by the tempering consists in a rapid approximation of the particles acting in every direction. It is this concussion which M. Caron regards as producing the combination of the iron and carbon. The increase of temperature has the effect of dilating the metal and giving to the molecules a mobility necessary to enable them to unite; the sudden cooling bringing them rapidly together, causes combination.

A bar of iron, heated to a bright redness, was briskly hammered on an anvil covered with finely-powdered carbon, when it had cooled to a dull red-heat, it was suddenly plunged into cold water. Some parts of the bar were then found to have been converted into steel at the surface, and resisted the file. The same iron, heated to redness, and cooled in the midst of charcoal, without being hammered, did not present any trace of being converted into steel when tempered in the same manner.

Hammering does not effect so complete a combination as tempering, because it causes the concussion of the particles only in one direction; while the sudden cooling in water causes their concussion in every direction simultaneously. Moreover, the temperature of the metal, after hammering, tends to destroy the combination that has been effected by it. On the contrary, the metal being quite cold after the concussion produced by plunging it into water, no further reaction is possible, except by heating the metal again.

Reaumur* and Ruiman† state that the volume of tempered steel is 1-48th greater than that of soft steel. Karsten,‡ on the

Comptes—Rendus, lvi., 43. † Comptes—Rendus, lvi., 211.

* "L'Art de Convertir le Fer Forgé en Acier," p. 338.
† Ruiman, I., 220 to 228. ‡ Karsten, III., 380.

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contrary, says that it is not quite certain that all steel expands by tempering, and becomes of less density. In M. Caron's experiments on the subject, he heated the steel in earthen tubes filled with hydrogen. A bar of hammered steel, one centimetre square and twenty centimetres long, was tempered, and found to be reduced in length to the extent of half a millimetre; the other dimensions were increased 0·06 mm.; the density was rather less than before, 7·796 in place of 7·817. These differences being small, the experiment was repeated several times, with the following results:—

	Before tempering.	After tempering. 10 times.	20 times.	30 times.
Dimensions in Centimetres	20·00	19·50	18·64	17·97
	·94	·96	·97	1·00
	·93	·96	·97	1·00

Hence it appears that the reduction in the length of a bar, after thirty temperings, was nearly one-tenth. The diminution in length was not due to oxidation, and the sharpness of its edges was retained almost entirely. The bar was then cleaned, and the density found to be 7·743; consequently the volume had increased.

Similar experiments with a great number of bars of steel gave like results, and M. Caron concludes, that in tempering, steel bars are reduced in length, while the width and thickness augment in the same proportion as the density is reduced.

The opinion expressed by Karsten, and the differences observed in steel of different manufacture, induced M. Caron to continue his examination to drawn and sheet steel, with the following results:—

	Dimensions before tempering.	Dimensions after tempering.
Round drawn bar steel.	20·05	19·98
	1·16	1·16
Rolled steel (German plates).	20·00	20·45
	1·51	1·51
	3·70	3·70

These results, and those already given, show that in tempering—

1. Hammered steel bars are reduced in length.

2. Round bars, partly hammered and partly drawn, are scarcely altered in length.

3. Plate-steel increases both in length and width.

4. In all cases the density diminishes—a result which agrees with M. Regnault's observation, that soft steel is denser than tempered steel.

It appears, therefore, that a bar of steel may, in tempering, change its dimensions in a different manner, according to the mode of its manufacture. This accounts for the fact that slender articles, such as files, become twisted; this would naturally be the result if, in forging, one side was more hammered than the other. At the moment of immersion in water, the side that has been most hammered diminishes in length more than the other, so giving rise to the defect.

The effect of the sudden cooling of steel in tempering, may be compared in other respects to the effect produced by the blow of a hammer. Thus, the more sudden it is, the more considerable is the corresponding force exercised, and the greater will be the hardness. This may be inferred from the following table, representing the time of cooling of a bar of steel, and the corresponding degrees of temper produced in the metal:—

	Water.	Water.	Water with 10 per cent dextrine.	Alcohol
Original temp. of the liquid	10°	50°	10°	10
Final temp. of the liquid .	22°	61°	23°	30·5°
Time of cooling . . .	4″7	11″3	13″2	21″7
Degree of temper . . .	good	slight	very slight	none.
Shortening of the bar . .	1-28	1-147	1-172	insensible

The result of a great many experiments with various liquids—mercury, saline or acidulated solutions, water covered with oil, or containing in solution mucilaginous or syrupy substances, oil, &c.—appeared to indicate that the hardness and other characters produced by tempering are inversley proportionate to the square of the time of cooling.

M. Deville* regards these results as accordant with the results of his observations on the remarkable physical and chemical properties communicated to substances by rapid cooling; or, in other words, the excessive proportion of latent heat, or heat of constitution, they retain when suddenly cooled.

Those observations showed that substances might, in this respect, be divided into two very distinct classes.

One class comprises sulphur, selenium, silicium—or rather its compounds, silica and silicates, and the experiments of Jacquelain, Lavoisier, and Silliman justify the addition of carbon to these. The other class includes lead, tin, bismuth,

* Comptes—Rendus, lvi., 325.

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and probably metals generally. The substances of the former class are "superfusible," and capable of being tempered, and acquiring the vitreous or amorphus condition. The substances belonging to the second class present the same molecular condition after cooling, either rapidly or slowly, their density remaining constant.

M. Deville considers that the results obtained by M. Caron may be explained by regarding iron and carbon as belonging respectively to these two different classes. These results, and Karsten's, show that iron and carbon combine at a high temperature; that if the compound is allowed to cool slowly, the constituents crystallize separately, the mass acquires a maximum density, and acids effect its separation into iron and a graphitic substance. On the contrary, when the cooling is sudden, the carbon remains in a state of superfusion, and communicates the property to the compound containing it, in the same manner that silica communicates this property to alkalies and metallic oxides.

When the proportion of carbon is larger than in steel, rapid cooling gives white pig iron, and slow cooling grey pig iron.

From this point of view, steel may be compared to glass, which becomes divitrified when it is heated; or to sulphur, which becomes octahedral sulphur when heated to near 100°C. It is indeed worth inquiry whether in the tempering of steel the effect produced is not absolutely similar to that observed in tempering sulphur; that is to say, the production of two distinct layers, one superficial and very thin, the other internal, and corresponding respectively to insoluble and soft sulphur.

In any case, the sudden approximation of the molecules determined by tempering, and compared by M. Caron to the effect of hammering, maintains permanently a greater distance between the molecules than their gradual approximation by slow cooling.

As regards heat of constitution, there is in such a case a retention of a certain quantity of heat; which is, on the contrary, disengaged during slow cooling. This is the condition which M. Deville terms superfusion.

In the case of the different kinds of allotropic sulphur, it has been possible, to some extent, to measure the quantity of heat evolved during the transformation of soft sulphur and insoluble sulphur into octahedral sulphur. In the case of steel, the density and calorific capacity afford only indirect evidence of the existence of similar conditions.

M. Deville considers that not only carbon is capable of converting iron into white pig iron or steel, but that, in accordance with the views above expressed, any of the electro-negative elements, placed in the same condition as carbon, would have that effect. Nitrogen he considers to be especially suited for this purpose.—*Chemical News.*

THE TIME GUNS.

The success which has attended the establishment of the Edinburgh Time Gun, which has now been in satisfactory operation above two years, has attracted the attention of various localities, with a view to the introduction of a similar time signal. Newcastle-on-Tyne, in particular, has been moving in the matter, and arrangements were made for firing a gun there daily at one o'clock, during the recent meeting of the British Association, simultaneously with the gun at Edinburgh Castle, and by means of the same electric discharge. The time was taken from the chronometer in the Royal Observatory, Calton-hill, Edinburgh, which is regulated to Greenwich time by daily observations, and the current was conveyed along the wires of the Electric Telegraph Company, (other messages being for a few moments suspended), impelled by Professor Wheatstone's magnetic exploder. The apparatus, first tested by the ignition of fusees, was previously brought into operation by the discharge of the gun, which told the time to the people of Newcastle at the exact moment of the signal being heard in Edinburgh. It is estimated that the deflexion for loss of time did not exceed the tenth part of a second, although the distance to which the current had to be sent exceeds 125 miles. The experiments for the introduction of the signal were conducted at the request of the Tyne Commission, by Professor Smythe, Astronomer Royal for Scotland; Mr. N. J. Holmes, of the Universal Private Telegraph Company; Mr. F. Ritchie, Edinburgh; and Mr. D. Reid, Jun., Newcastle. It was intended, also, to fire a gun at North Shields, by the same electric discharge, during the meeting of the British Association, and the hope has been generally expressed that the practicability of the arrangement being proved, the signal will be permanently established on the Tyne as well as on the Forth. On the gun at Newcastle being first fired, the Mayor sent a complimentary message to the Lord Provost of Edinburgh, which his lordship received

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while presiding at a meeting of the Town Council, and which he read to the meeting. The Mayor, in his message, expressed the hope that he should have his lordship among his guests at the approaching meeting of the British Association. The Lord Provost, in his immediate reply, congratulated the Mayor on the successful introduction of the signal, returned thanks for the invitation, and expressed the hope that the approaching meeting would be a highly successful one.—*Times.*

Arrangements are being made for the establishment of a Time Gun in Glasgow. The scheme, however, is to be experimental in the meantime, and will only become a permanency in the event of its being successfully carried out, and coming to be regarded by mercantile men, and the community generally, as a public benefit which ought to be retained. It has been originated by the Universal Private Telegraph Company, who have already pushed their plans to a stage of advancement which promises its speedy completion. A 32-pounder gun is being erected in a central part of the city, and as it is surrounded by houses, the piece will only be charged with from 1½lbs. to 2lbs. of powder, instead of 6lbs. which it could safely stand. The disadvantages of the present site, as necessitating such a restricted charge, are obvious, and it is therefore probable that another position for the gun will be obtained in the outskirts of the city, where it may be loaded with the full 6lbs. of gunpowder. Professor Piazzi Smythe, the Astronomer Royal for Scotland, has arranged his clock in the Edinburgh Observatory, so that the electric current will be passed to the Glasgow gun simultaneously with the firing of the Newcastle, North Shields, Sunderland, and Edinburgh pieces. The first experimental gun will be fired, it is expected, on Thursday next, at 1 p.m., Greenwich mean Time.—*Times.* Sep. 30th, 1863.

ABRIDGEMENTS OF SPECIFICATIONS OF PATENTS RELATING TO WATCHES, CLOCKS, AND OTHER TIMEKEEPERS.

A.D. 1852, December 23.—N° 1148.

ROPER, WILLIAM.—*This invention did not proceed to the Great Seal.* It consists, according to the Provisional Specification, in "shaping sheet "metal into boxes, watch cases, and other articles, "by the employment of soft metal (subjected to "pressure or impact) to cause the sheet metal to "take the form of dies, the soft metal acting as a "forcer, and is melted out after the desired form "has been obtained, by which means not only is "form or shape given to the metal, but at the "same time any engraved or other ornaments on "the dies are produced on the metal."

[Printed, 2½d.]

A.D. 1852, December 29.—N° 1187.

KIBBLE, HENRY.—*Void by reason of notice to proceed not having been given within the time prescribed by the Act.*—The Provisional Specification declares the nature of this invention for "A Traveller's Monitor, or Ticket and Parcel "Protector," to be as follows:—"A double "casing is made to a hunting watch, having a "pendant through which the chain or ribbon "(used to suspend the monitor as a watch) is "passed. The interior face of the dial is num- "bered similar to a watch, but with any number "of figures from 1, upwards. The exterior or "surface has an elastic spring passing over its "centre, attached at one end, but capable of being "opened, if required, to renew the spring or "otherwise. Through, or rather under, this spring "is passed the railway ticket, securing the same "between the spring and the back of the monitor. "There is also a circular hole in this outer case, "through which is seen, on removing the ticket, "the number, which has been set by the traveller, "of his parcels or luggage. The work in the in- "interior consists simply of a cog wheel, slide "and ring."

[Printed, 2½d.]

BRITISH HOROLOGICAL INSTITUTE.

LIST OF NEW MEMBERS SINCE THE LAST PUBLICATION.

Mr. W. R. Jeffery, Scarborough, Yorkshire.
„ Thomas Heyes, 4, Portland cottages, Downham road, N.
„ William Morris, Blackheath, S.E.
„ William Bennett, Kingsbridge, Devon.
„ H. Bickley, 6, Half-moon cres., Barnsbury road, N.
„ —Cox, 34, Southampton row, Russell sq., W.C.
„ Charles Redfern, 10, St. Paul's street, New North road.
„ A. Curryer, 67, Bride street, Liverpool rd. N
„ G. Pitkin, 15, Upper Charles st., Northampton square.
„ George Prickett, 5, Corporation row, Clerkenwell.
„ Alexander Dallas, 77, Church st., Inverness.
Messrs. McMaster and Son, Grafton st., Dublin.
Mr. W. Gillett, White-horse road, Croydon.
„ W. Hutton, Castle street, Liverpool.
„ H. Harrison, Castle street, Liverpool.
„ J. Penlington, Castle street, Liverpool.
„ A. Guye, 8a, Guildford street, Russell square.

PROVISIONAL PROTECTIONS.

Dated August 26th, 1863.

2107. S. FATTORINI, 3, Rue Joubert, Paris, optician and mathematician.—A new division of time, and the application thereof to mathematical and other instruments.

Dated August 31st, 1863.

2150. W. E. GEDGE, 11, Wellington Street, Strand.—An improved watch. (A communication.)

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., SEPTEMBER, 1863.

Gray's Inn Road.

Days of the Month.	Barometer, at 32° F, and mean sea level	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9A.M.	During the next 24 hours
	Inches.	o	o	o	o				
1	30·100	55	51	67	48	WNW	3	b	bc
2	29·900	58	56	64	53	SSW	4	r	r, bm
3	·770	60	55·5	63	54	S	3	cb	cb, rr
4	·920	59	55	67	52	SW	4	cb	p, bc
5	·856	57	53	65	49	WSW	4	b	rr, bc
6	·933	52·5	48·5	62	48	NW	6	bc	bc, rr
7	·562	60·5	58	62	51	NW	6	o	cb, b
8	30·000	55	51·5	64	48	W	3	c	o, mr
9	29·807	57	55	61	51	S	2	mr	om, rllt
10	·897	53	50·5	64	49	NW	2	cb	cb, ll, b
11	30·207	52	48·5	60	45	NNW	3	b	cb, b
12	·264	54	50	61	47	WNW	2	c	o, mc
13	·281	57	53	61	50	NW	4	c	cb
14	·370	53	50	63	48	NW	2	o	o
15	·240	56	51	60	51	WNW	2	o	o, cb, r
16	·061	57	55	59	52	WNW	3	cb	cb, b
17	·157	53	50	62	46	WNW	3	b	b
18	·128	57·5	53	63	51	SW	2	o	cb, bm
19	29·845	60	57	64	54	S	1	cb	bc, oq, rr
20	·644	53	51·5	70	50	WSW	3	or	cb, b, r
21	·217	52·5	48·5	60	47	SW	4	cb	hr, bc
22	28·987	51	48	58	47	WSW	3	o	or, b
23	29·113	49	46	58	43	WSW	3	b	rr, b
24	·376	50	48	56	44	SSW	2	r	rr, bm
25	·675	51	48	56	44	W	1	b	bc
26	30·044	48·5	46·5	61	43	NW	2	bm	bc
27	·217	52	48	58	42	SSE	2	bc	cbm
28	29·743	56	54	57	51	SW	6	rq	r, bc
29	30·067	48	46	56	41	Calm	0	bm	b
30	29·930	45	43	58	38	E	1	m	bc, rr
	29·874	54·1	51	61	44·6		2·9	Mean.	

REMARKS.

The atmospheric pressure was greatest at 10 a.m., 14th, when it was equal to a column of mercury, 30·39 inches high, and least, about 6 p.m., 22nd, being only 28·96 inches; hence the range was 1·43 inches.

From 10 to 12 p.m., 9th, there was a severe thunderstorm.

Between noon and midnight, 19th, the wind blew a gale from S.W. to W.; then it moderated and rain set in until 10 a.m., 20th, during which ten hours, a depth of 0·68 of an inch of water fell on the ground. The wind again reached the force of a gale during the night of the 27th. Between the 27th and 30th, the wind veered round the compass from S.E. to S., W., N., E. to S. and W. again.

Rain to the amount of 3·20 inches fell, on 16 days, during about 84 hours.

Referring the 9 a.m. wind observations to the cardinal point, it appears that a N. wind blew on 5 days; E., 1; S., 9; W., 14; and one day was calm.

The barometer has been on the average lower than usual; the rain-fall has been more than an inch in excess; the most frequent winds have been the south-westerly, as usual for the month; yet the temperature has been several degrees below the mean value; the month was, therefore, decidedly colder and wetter than usual.

INDICATIONS FOR DECEMBER.—The middle day has only 7h. 46m. The highest day temperatures average 45°, the lowest, at night, 36°. The barometer averages 30 inches, with a mean range of 1·5 inches. Westerly winds are the most frequent. Rain or snow falls on 12 days to the amount of about two inches. About half the nights are usually frosty.

EQUATION OF TIME TABLE

For November, 1863.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *added* to Mean Time.
		m. s.	s.	m. s.
Sun. . .	1	16 16·57	0·066	16 16·59
Mon . .	2	16 17·75	0·032	16 17·76
Tues . .	3	16 18·10	0·003	16 18·10
Wed . .	4	16 17·60	0·038	16 17·59
Thurs .	5	16 16·28	0·073	16 16·26
Fri . . .	6	16 14·11	0·108	16 14·08
Sat . . .	7	16 11·09	0·143	16 11·06
Sun. . .	8	16 7·21	0·179	16 7·16
Mon . .	9	16 2·49	0·215	16 2·43
Tues . .	10	15 56·90	0·251	15 56·83
Wed . .	11	15 50·47	0·286	15 50·39
Thurs .	12	15 43·17	0·321	15 43·08
Fri . . .	13	15 35·05	0·356	15 34·96
Sat . . .	14	15 26·08	0·391	15 25·98
Sun. . .	15	15 16·28	0·426	15 16·17
Mon . .	16	15 5·64	0·460	15 5·53
Tues . .	17	14 54·19	0·494	14 54·07
Wed . .	18	14 41·91	0·528	14 41·78
Thurs .	19	14 28·84	0·562	14 28·70
Fri . . .	20	14 14·96	0·595	14 14.82
Sat . . .	21	14 0·28	0·628	14 0·14
Sun. . .	22	13 44·82	0·661	13 44·67
Mon . .	23	13 28·58	0·693	13 28·43
Tues . .	24	13 11·57	0·725	13 11·42
Wed . .	25	12 53·79	0·756	12 53·63
Thurs .	26	12 35·26	0·787	12 35·10
Fri . . .	27	12 16·01	0·818	12 15·84
Sat . . .	28	11 56·00	0·848	11 55·83
Sun. . .	29	11 35·28	0·878	11 35·11
Mon . .	30	11 13·86	0·907	11 13.69

ERRATUM.

Page 14. No. 62. On last line, 1668, should read, Robert Hook, Invt., 1658.

All Communications for this Journal should be addressed to the EDITOR, *at the Office*, 35, Northampton Square, Clerkenwell.

Our pages are at all times open to correspondence and contributions, either original or compiled from good authorities.

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EDINBURGH HOROLOGICAL SOCIETY.

THE third half-yearly meeting of the Edinburgh Horological Society was held on Wednesday, 4th November, in the Goldsmith's Hall. Mr. David Meek, President, in the chair.

A paper was read by Mr. John McKay upon astronomical clocks. In the course of his paper, the essayist described a peculiar description of regulator (which he also illustrated with diagrams), having only *three* wheels, showing hours, minutes, and seconds, a hand being carried upon each of the arbors. This paper is the first contribution to the Society's *Sketch Book*, a book which has been introduced into the library to enable the members to describe and illustrate therein anything new or novel in connection with Horology. After an animated discussion, a cordial vote of thanks was accorded to Mr. John McKay for his excellent paper.

The Secretary, Mr. David Spencer, then read the half-yearly report, in which, after tracing the working of the Society for the past six months, adverted in eloquent terms to the excellent papers that had been read in that period. He also, at some length, dwelt upon the growing importance of the library:—how its value was enhanced by some very valuable books presented during the past six months, and referred to Mr. Woodcroft, of Her Majesty's Patent Seal Office, who, in the handsomest manner, had presented the library with 12 volumes, the value of which cannot be over estimated.

The Treasurer gave in his report, which showed the funds of the Society to be in a healthy condition.

The following gentlemen were elected office-bearers for the next half-year.

President: Mr. David Meek.
Vice-President: Mr. John McKay.
Treasurer: Mr. J. L. Donald.
Secretary: Mr. David Spencer.
Members of Committee:
J. More, L. Cross, D. Campbell, W. Sym, R. Falkoner, J. Tennant.

It was intimated that Alex. Bryson, Esq., F.R.S.E., has kindly agreed to read a paper at the meeting in December.

COVENTRY WATCHMAKERS' ASSOCIATION.

The fifth annual meeting of the above association was held in St. Mary's Hall, Coventry, on Monday, October 12th. There was not a large attendance.

Mr. H. BAND having been voted the chair,—

Mr. C. SHUFFLEBOTHAM, in the absence of the Secretary, Mr. May, who was prevented attending by illness, read the

FIFTH ANNUAL REPORT.

"Your Committee, in submitting their 5th Annual Report, are glad to notice that there has been an increase in the quantity of work during the past half-year, and as trade generally, throughout the country, is still improving, and in many branches wages rising, they sincerely hope that the day is not distant when the same remarks may be applied with equal truth in relation to the watch trade.

"The Petition to the House of Commons in favour of extending the provisions of the Truck Act to the Watch Trade was presented by the late Right Hon. Edward Ellice, and that gentleman also had interviews with the Board of Trade in furtherance of the same object; but at present there appears little prospect of its accomplishment, unless the whole of those places that are the centres of the watch trade make a combined effort to influence Parliament to a favourable consideration of the subject.

"The Committee refer with pleasure to the announcement that has appeared in the newspapers of the Manufacturers offering £20. for a prize essay for learners, and they sincerely hope that good will result; and it likewise affords them much satisfaction to find that our example is being followed in London, and that funds are being collected at the British Horological Institute for prizes for the best essays 'on various departments of Practical and Theoretical Horology;' and also that the Gauge Committee of that Institute have made considerable progress in surmounting the difficulties attendant on the effort to establish a uniform system of gauges for the watch trade; and your Committee conceiving that, as a National Institution representing interests so important and so identified with our own, it had especial claims to our support, have entered the Coventry Watchmakers' Association as a subscriber to the British Horological Institute of one guinea per year, to aid to develope the science of Horology, and to promote the interests of the trade.

"In reference to the prizes offered by the Association for improvements in the watch movement and the workman's tools, your Committee have to state that but one tool has been sent in to the Secretary, which has been submitted to the inspection of Messrs. H. Band, W. Trickett, and J. Kingston, who were appointed by your Committee as adjudicators, and the following is their report:—

"'*To the Committee of the Coventry Watchmakers' Association.*—Gentlemen: We, the undersigned, herewith inform you that we have examined

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and tried the tool submitted for our inspection, viz.: a tool (stated by exhibitor) 'to facilitate the pivoting and turning of the various parts of a watch.' We are of opinion that the said tool is not a new invention, neither would it be an advantage over the tools at present in use among watchmakers for similar purposes.—Signed), Joseph Kingston, H. Band, Wm. Trickett.'

"Your Committee regret that so little emulation has been shown by the artisans and others in our trade in competing for these prizes. Whether this arises, as has been suggested, from the reward being inadequate to the work desired, we cannot say; but as we claim no property in the improvement, we do not think this is the sole cause. If, however, we could add to the amount offered, it would no doubt stimulate a greater number to exertion. Your Committee think it will be best to wait the result of the prizes offered by them in conjunction with the watch manufacturers of Coventry before issuing any amended scheme.

"The establishment of a Museum in Coventry has long been desired by the friends of education, and your Committee conceiving that the money in hand arising from the Penny Readings might be most advantageously applied in commencing such an institution, presented the following memorial to the Committee for conducting them, in favour of that proposition:—

"*To the Committee for conducting the Penny Readings in the City of Coventry.*—The Memorial of the Committee of the Coventry Watch Makers' Association respectfully sheweth, that the establishment of Penny Readings has shown that there is a growing desire for intellectual and moral recreation, and the surplus funds in hand prove that they may be made available as a source of pecuniary assistance in providing further appropriate means for supplying entertainment and instruction. That the examination of collections of articles of interest, embracing objects of natural history and works of art in all their diversities and peculiarities, are calculated to enlarge the comprehensive faculties of man, to improve his taste, and promote generally his intellectual, industrial, and social progress. That the want of such an Institution in Coventry has long been felt as a void by all persons feeling an interest in the important subject of general education, and more especially that portion of them who from experience can appreciate at its proper value the advantage of objective teaching when applied in illustrating the social history of our race. We, your memorialists, therefore pray that you will be pleased to take this subject into consideration in disposing of the profits in hand arising from the Penny Readings, and devote them to forming a nucleus for the establishment of a museum, feeling confident that so good a work having been once commenced, our generous and intelligent citizens, upon application being made to them, would contribute both specimens and funds, and the promoters enjoy the pleasure of having founded an educational institute, of a pre-eminently practical character, from means derived from the most novel and popular entertainments that have yet been introduced into our city. And your memorialists will ever pray.—JOSEPH BALES, Chairman; WM. MAY, Secretary.—Committee Room, August 24, 1863.'

"There are seven vacancies in the Committee to be filled up by the present meeting, and we sincerely urge upon the watch trade the important influence that the principle of association is assuming in all parts of the country, and earnestly desiring that the watchmakers of Coventry may be recipients of its benefits, we trust they will cultivate that spirit of good will and self-reliance so essential to success in all combined social action; and whilst they persistently endeavour to understand this, the most important question of the age—the social advancement of our class—that they will discountenance all antagonistic feeling, and evince a spirit of conciliation in the discussion of rights and duties, and thereby secure the sympathy and good-will of all who desire the elevation of the working man.

He believed they had all seen the futility of trying to influence wages by a society of that kind, and thought it would be much more conducive to trade interests for them to turn attention to other matters connected with the watch business.

Mr. J. BALES proposed the adoption of the report, and proceeded to speak in reference to several matters mentioned in it. With respect to the manufacturers' price for the best essay on the watch trade, he might say that he expected some competition, as many had applied for the conditions under which the essay must be written. With regard to the Association having become a subscriber to the Horological Institute, he thought it was only fair that it should, as the Institute had afforded it with much courtesy, every assistance. He thought all watchmakers would agree with him on the necessity of the gauging system. It was very difficult without a universal system of gauging in the case of an accident to a watch wheel to obtain another to exactly supply its place. After mentioning that the only tool sent in for competition was but an attempt to carry out an old system, he alluded to the benefits which might accrue from the establishment of a local museum in which might be treasured up specimens of ribbon and watch manufactures.

Mr. LEE seconded the adoption of the report, *nem con.*

Mr. W. TRICKETT submitted the following proposition:—

"In order to lesson the expenses of the association it is hereby proposed that the half-yearly meetings be discontinued, and that one-half the committee retire annually.

The motion was seconded and carried.

Mr. C. SHUFFLEBOTHAM moved the following:

"It is hereby proposed that the minimum subscription be 2s. annually, or 6d. per quarter, and that all those who are twelve months in arrears from this date be considered as non-members."

After commenting on the report, Mr. SHUFFLEBOTHAM said it had been stated that the watch trade was entirely leaving Coventry, and the London press were beginning to re-echo that assertion. Now, inquiries had been made at the different assay offices as to the returns for the last five years.

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It was thought that it would be desirable to know what falling off there had been in the trade, and if there had been so terrible a diminution, that efforts might be made to regain it. Now it was found from the returns (the Birmingham and Chester offices were the only ones completed, the London returns being only for two years), that all the falling off that there was could be attributed to the loss of the American trade, and had it not been for the American war there would have been an increase in the manufacture of Coventry watches. Mr. Shufflebotham next referred to the establishment of a library composed of books on scientific subjects, they had already the beginning of one, in which were several volumes of the *Horological Journal.*

The resolution having been seconded,

The CHAIRMAN said he himself had felt very anxious to know the returns from the Assay Offices, inasmuch as it would give them a good idea of the state of the trade. The London Assay Offices had not made any returns since 1860, but he hoped the committee would take in consideration and urge upon the London offices to make complete returns, so that they might be printed and distributed amongst the members of the watch trade. The Chairman then proceeded to state the returns as far as they had been completed. It appeared that there were, in the year ending April, 1859, 24,556 gold, and 78,416 silver watch cases essayed at the London Goldsmiths' Hall. In the year ending April, 1860, the numbers were 26,966 gold, and 90,320 silver cases. The Birmingham returns showed the following results:—In the year ending June 30, 1859, there were essayed 68 gold watches, and 24,236 ounces of silver in watch cases, (the returns of silver cases at this office being calculated in ounces.) In 1860 there were 52 gold, 24,103 ounces silver cases; in 1861, 36 gold, 17,376 ounces silver; in 1862, no return of gold, 16,040 ounces silver; in 1863, there were 36 gold, 13,913 ounces silver. At Chester the returns were:—1858-9: 9,341 gold, 17,596½ silver cases. 1859-60: 15,714½ gold, 24,745½ silver. 1860-61: 10,699 gold, 26,630 silver. 1851-62: 9,634 gold, 21,192½ silver. 1862-63: 12,410 gold, 19,899½ silver cases. The chairman mentioned that there were existing in the United Kingdom the following "Halls":—London, Chester, Exeter, York, Newcastle-on-Tyne, Birmingham, and Sheffield. There had been "Halls" at Bristol and Norwich, but these were now defunct. In Scotland, there were "Halls" at Edinburgh and Glasgow; in Ireland at Dublin. The half-cases mentioned in the figures above refer to watches which wind on the dial.

The resolution was put to the meeting and carried.

A resolution, empowering the Committee to use efforts to obtain full particulars from the assay offices, was passed.

The retiring members of the Committee—Messrs. H. Band, Josiah Davis, C. Shufflebotham, W. Warren, John Butler, J. Suddens, and J. Polton—with the exception of the two latter were re-elected. Messrs. W. Trickett and J College were appointed on the committee in the place of Messrs. Suddens and Polton.

A vote of thanks to the Chairman, and one to the Mayor for the use of the Hall, terminated the proceedings

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TO THE EDITOR OF THE HOROLOGICAL JOURNAL.

SIR: Perusing the rates of Chronometers given this month in the Journal, an old thought has recurred to me in connection with temperatures, which somehow, I think, will be worth mentioning publicly. I read of a great number of different auxiliaries to a compensation balance being applied, which must cost an enormous amount of time and money, and they sometimes seem much more successful than at others; but there is another important thing to be attended to, which I never hear anything about. Was it noticed, at a given temperature, how the whole interval of time between the beats was divided (or supposed to be divided as near as can be told), when those auxiliaries were most successfully applied? Or, what is the same thing,—Were the arcs of the escapement and the vibration noticed, to see they were the same, as near as possible, at a given temperature? An auxiliary evidently causes the inertia of the balance to be changed in some particular ratio; but what would be the use of it if the times were materially different? *i.e.* if the fixed arcs and the free arcs take different fractions of the whole interval of time between the beats in different chronometers.

If the machinery of watches and chronometers was quite perfect, and temperature acted upon the metals invariably the same, it would require a scrupulous exactness in the division of the time which elapses between two beats, to obtain precisely the same effect through a range of temperatures with any sort of compensation balance or auxiliary to it.

In any machine, if we had a perfect adjustment of the main spring, wheels and pinions, dead true and equal, 'scape wheel registering true (or permitting the fourth wheel to do so), frictional actions equal in positions, and could get over a few other minute affairs in positions in different escapements, then the time by the dial would wholly and solely depend upon the fixed arcs, and the free arcs so falling in together as to form an "integer;" so that the free arcs of the balance became the precise complement of the fixed arcs of the escapement and train wheels; and if these two motions could not be got to agree so as to form the integer, as per train, then the dial would show the aggregate of the defects from the integer, and the watch either lose continually or gain continually all day long; if the wheels and fixed arcs took the fraction one-tenth, the free arcs must take the other fraction nine-tenths, unlocking inclusive; if the fixed arcs took the fraction one-twentieth, the free arcs must take the other fraction nineteen-twentieths, unlocking inclusive; or in any other ratios as the case may be. The motion of the train wheels by being intermittent, instead of continuous, as the dial latently implies, permits an integer to be formed

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in many ratios; and whatever may be the ratio in which the two motions happened to fall in together, in that same ratio would there have to be a loss of one motion to gain of the other motion, to bring the dial right at the first change of velocity, as induced by change of temperature; and if the compensation was so adapted as to cause the motions to again agree, then both their fractional times are changed; and at the next change of velocity, the loss of one motion to gain of the other motion, would have to take place in these new ratios.

To Exemplify.—Let it be granted that the whole interval of time between two beats is divided, as, one-twentieth for the wheels and fixed arcs, and nineteen-twentieths for the balance's free arcs, together they are twenty-twentieths,—one whole. Let the temperature so affect the metals, and particularly the reciprocating spring, as to destroy this integer. Let the compensation be so adapted that the balance's gyre flows inwards, and by lessening the inertia permit an integer to be formed anew, in which the wheels move one-twentieth quicker than they did before, (gain), and the free arcs take one-twentieth of one-twentieth, equal to one four-hundredth of the whole beat longer than they did before, (lose). Now the time of the wheels and fixed arcs is one-twentieth, minus one four-hundredth, equal to nineteen four-hundredths of the whole beat; and the time of the free arcs is nineteen-twentieths, plus one four-hundredth, equal to three hundred and eighty-one four-hundredths of the whole beat, together they are four hundred four hundredths,—one whole; in which new fractional times the loss to gain will have to be effected at the next change of velocity as induced by change of temperature. As to the actual rate at which they will change no human being can divine; but it is perfectly transparent, that as the time of the wheels get shorter and shorter, or longer and longer, so the time of the free arcs will have to increase and decrease in an equivalent ratio to keep the dial to the same time; *but these ratios are not equal for equal changes of the wheel's velocity; but have a less ratio, as the wheel's velocity increases, and a greater ratio as the wheel's velocity decreases,* "*with one exception*," (which I will speak of presently, when I have proved the foregoing assertion), for instance: Let the wheels move one-twentieth quicker now again, then their time is only $\frac{361}{8000}$ths of the whole beat, and the time of the free arcs must be the other $\frac{7639}{8000}$ths, together $\frac{8000}{8000}$=one-whole, and the three different times range as under:—

Fixed arcs $\frac{400}{8000}$ths=$\frac{1}{20}$th, $\frac{380}{8000}$ths=$\frac{19}{400}$ths, & $\frac{361}{8000}$ths.

Free arcs $\frac{7600}{8000}$ths=$\frac{19}{20}$ths, $\frac{7620}{8000}$ths=$\frac{381}{400}$ths, & $\frac{7639}{8000}$ths.

So that to this assumed data the difference in the first two changes is $\frac{20}{8000}$ths of a beat, while in the last two changes it is only $\frac{19}{8000}$ths of a beat, clearly showing what I have stated; and if we were to assume the mean of these times, as the time of the chronometer at the mean of the temperatures the chronometer was placed in, then it is self evident that there are different ratios in the times above and below the mean, or at least, there *must be* a different ratio in the times above and below the mean to bring the dial right for equal changes in the velocity of the wheels and fixed arcs.

The exception to the foregoing is,—That if at the mean temperature the wheels were moving at their mean velocity, and the whole beat happened to be divided into two simple fractions *exactly*, then, both above and below that mean, the ratios of addition or subtraction will be equal, for equal changes of velocity of the wheels. It is needless for me to continue these calculations, because he who would thoroughly understand it, must be able to do it for himself; all I can do, is to suggest to those whom it may concern, to closely watch the way the beat's whole time is divided at some given temperature when they apply any special compensation.

To preserve an integer whole, in the same fractional times as it existed at a previous temperature, requires the angular velocity of both the free arcs and the fixed arcs to be kept the same; and this cannot be done without acting also on either the 'scape or fourth wheels, or as we may familiarly term it, both the power and the weight, the reciprocating power being already acted on by temperature. I have often thought it would be practicable in such a large machine as a box chronometer, where there is a strong main power, but of course patience and practice alone can tell. The plan I should adopt is, to place a very small ruby collet on either the 'scape or fourth wheel arbors, and have an exceeding delicate compound piece of metal of a curved form, so that the changing temperature might cause this compensation to press lightly on the ruby collet, imposing a frictional action on the pivots, and thereby lessen the force of impulse when the reciprocating spring relaxed and the balance's gyre flowed inwards, or it might be made to expand outwards if required, and take off a frictional action already on, thus forming a sort of reservoir of main power to be brought into use as required.

In conclusion, Sir, I beg you will observe that the foregoing observations are based upon an assumption that the machinery is perfect, for in no other way can there be any reasoning upon temperatures; but if the machinery is not perfect, then it requires a still further consideration of the nature of watch motions; but in every case the data must be assumed for exemplification, because, as a rule, if we take a long period of time, such as a day: then by the end of it the dial only shows the *differences* of the excess and minus of what should be an integral sum of these two motions; and when these *differences* are in excess of this sum, the watch is said to gain, or if they are minus the sum, the watch is said to lose; and however useful it may be for the general purposes of life, yet it will not teach a watchmaker much about casualty.

I remain, SIR,
Your obedient servant,
THOS. CHAS. SCOTCHFORD.

7, Richmond Grove, Barnsbury,
November 9th, 1863.

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CONTEMPORARY HOROLOGY.

AT the most flourishing periods of antiquity, the art indicating Time never attained to anything beyond the most rudimentary position.

Astronomical science transmitted by Babylon to Egypt, whence through the Greeks it was bequeathed to the Romans, was powerless to develope horological instruments from the early condition of the first inventors.

After noticing with their imperfect character the three-time recording instruments of antiquity,—the sun-dial, the hour-glass, and the clepsydra, and tracing through the humanizing influence of Christianity, and the results of monastic seclusion during the dark ages their development into the mechanical condition of the present clock, for the purpose originally of indicating on the bell of the church tower divisions of the day for religious duties, the writer proceeds :—To what name, to what country are we to attribute the first rudiments of the art of Horology, which may be strictly considered such ? On this point history is silent, tradition is obscure. However, from various conjectures of a great probability, it can be substantiated that France was the cradle of this rare art, and not Italy, as certain authors of that country have asserted.

For a long time Rome had ceased to be the Rome of progress. Intellectual activity, which hitherto had Italy for its focus, had thoroughly shifted its footing to the advantage of the Gallic-Roman provinces, which had become united under the Carlovingian dynasty. Thus Provence and Languedoc were enriched with celebrated schools, when nothing of this character remained on the other side of the Alps. The two monastic establishments of Lérins and Marseilles flourished in the seventh century, with a brilliant literary and scientific lustre, when the Italian peninsula was involved in confusion and barbarism. A century later, Charlemagne founds in Paris an University, which those of Bologna, Pavia, and Aix-la-Chapelle, also indebted to this monarch for their establishment, are far from excelling. To the French Benedictines we are indebted for the most important revivification of science and literature. The Paris University holds a pre-eminence over all foreign rivals. From all parts of Europe professionals and laity come to attend its classes, and hold it honourable to graduate there. From the monastic establishments of Gaul arise the most distinguished men, illustrious by the greatest intelligence of this period of the middle ages.

This relative superiority of France continued during the succeeding ages. Charles V. founds a library 110 years before that of the Vatican. The lost treasures of antiquity again see the day. Paris, Rouen, Lyons, and Toulouse make the first tentative efforts at manufacturing ideas, in their treatment of rich tissues, and in gold and silver smith's work. Finally, it is in the heart of France where has its origin—the architecture known as the Gothic, by the Italians falsely attributed to Germany—but the authenticity of whose invention has been established in our days, by the irrefragable evidence of the priority of erection of the French cathedrals over the edifices of this style in other countries. It is only during the period known as the Renaissance, that Italy reconquered the sceptre of the sciences and of the arts, since fallen from its grasp.

If the earlier steps of the progressive science of Horology fail to be discoverable, may we not, notwithstanding, conclude that this art must have had its origin in the spot where scientific research was most cultivated. What indeed is its first starting point ? Auvergne. And who holds the earliest position in the history of the art ? The French benedictine, Gerbert de Aurillac. Towards the end of the tenth century flourished this monk, who was elected Pope of Rome in the name of Sylvester II. Gerbert was possessed of vast information for his age,—in astronomy, geometry, and mechanics ; expert in the construction of sun-dials, sand glasses, and clepsydræ. To perfect his knowledge he visited the Moors of Spain, whence he returned to Auvergne, where he was much less busied in theology than in mechanics. He was the first to apply gravity as a motive power to clocks, and shortly after he invented the escapement,—the most excellent as well as the most useful mechanism in timekeepers. These precious discoveries were taken to Italy by their author, when he was named Archbishop of Ravenna, (A.D. 997), and subsequently elevated to the Papal chair two years after, (A.D. 999).

At the beginning of the twelfth century, 110 years after the death of Gerbert, the striking train was invented. By whom ? Doubtless by a Frenchman: since this wheel-work in use in France at this period is not to be found elsewhere till 50 years afterwards.

During the thirteenth century Horology was stationary. But in the succeeding century the art made a sudden and extraordinary advance. In 1314 a striking clock, made by Beaumont of Caen, was set up over the bridge of that town. Valinfort, a Norman benedictine, is invited to England. He there constructed, in 1324, for the Abbey of St. Albans, a mechanical striking clock, which showed the days of the month, days of the week, the planetary motions, and the hours of the tide. In 1314, James of Dondis, whose name only is Italian, constructed for the palace of Padua a clock, whose complicated character is not less remarkable. It was at this period that the use of clocks in palaces, town-halls, monasteries, and mansions became general throughout France. The cathedral clock of Strasbourg dates from 1354. That of Paris, constructed by Henry de Vic, at the cost of Charles V., was set up in the tower of the palace in 1372. Then follow the fine clocks of the Chateau of Montargis (1380), and that of the cathedral of Metz (1391). This latter struck the hours, chimed the quarters, showed the sun's course and the lunar phases.

In the fifteenth century, the art of Horology travelled beyond the limits of the country of its birth. It is found in Spain in the monumental clock of Seville (1401) ; in the North, in that of Moscow (1404) ; in that of Lubeck (1405) Strange to say, Saint Mark at Venice was not supplied with an instrument of this kind till 1493.

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Under Charles VII., that is in the first half of the fifteenth century, the main spring and the alarum are invented in France. This became the starting point of a considerable revolution in Horology. The main spring occupying but a small space, timekeepers lose by degrees their original bulky proportions. Becoming portable, they take elegant forms, and are enriched with chasing and engraving. Improvement progresses, and by the end of the century the watch exists under conditions very remarkable for this early period. The fuzee, a mechanism for equalizing the varying force of the main spring, is the invention of an unrecorded artist. Twenty years after, Gruet, a Frenchman, replaced by the steel chain the gut which has the twofold disadvantage of extending by the damp, and of contracting in dry weather.

In the sixteenth century, the Renaissance takes its brilliant place in the history of art. Various social, moral, and political causes brought about the termination of this extraordinary period. The genius of the Medici, of Julius II., and of Leo X., stimulating art in every branch, and under every manifestation.

The artists and intellectual men of Constantinople flying from Mussulman persecution on the subjugation of their country, came to graft the Byzantine on to Western art.

Then Italy becomes for Europe what Greece had heretofore been for her—a brilliant model of enlightenment and taste.

Horology borrows hence refinement in shape, taste in design, and perfection of finish in engraving and chasing; but the mechanism of the watch derived no advantage from this era. This continued almost exclusively the property of French practical men. Nevertheless in this department of the art much remained to be done. We find a proof of this in a well known historical fact. The Emperor Charles V., almost as good a mechanic as he was a great statesman, from lassitude had abdicated supreme power to retire to the monastery of St. Just. Enthusiastically fond of horology, and aided by the mathematician Turianus, he surprised the monks, his companions, by his ingenious applications of the horological art; but vainly did he exhaust himself in efforts to make his clocks keep time together, and strike simultaneously.

The solution of this difficult problem was reserved for plebeian intellects, and for an epoch nearer our own times, for the seventeenth century, and is due to Galileo and Huyghens.

II.

Horology became generally disseminated over Europe at the opening of the seventeenth century. Four countries at this period illustrated by the distinctive character of their productions the genius of each. Paris, where from the year 1540 Francis I. had constituted the watch and clock makers a guild, already furnished abundance of eminent practical men, who were distinguished as well by the elegance of their work, as by its mechanical excellence. In Venice, a progress of a different kind is established, for in that city watches were looked upon less for their timekeeping value than for being gems of extraordinary richness and wonderful ornamentation. Germany initiated the manufacture of a cheap article by the production of its oval watches, known as the "Nuremberg Eggs," well made watches, but heavy, bulky, and of a common finish. London had scarcely commenced this manufacture. Notwithstanding the impulse to art given by the elegant period of the reign of Charles II., English artists lacked originality, and were but servile imitators of the French model.

Under Louis XIII. no important progress was made. The form even lost some of the excellence due to the Renaissance. Under his magnificent successor discoveries and improvements rapidly followed each other. Discovered and turned to account for astronomical observations by Galileo, the pendulum became, in the hands of Huyghens, the starting point of a complete revolution in Horology. We may date from this period the the great precision and exactitude of the astronomical clock. Watches, however, from their portable character and constant change of position, would have benefited nothing by this great discovery, had not the spiral spring been discovered in 1674.

The Frenchman, Hautefeuille; the Englisman, Hook; and the Dutch, Huyghens; all disputed the originality of this important invention,—a discovery to which the first named seems to us to have a clearer claim than either of his rivals. A political event at this time profoundly disorganized French manufactures and watchmaking in particular.

In 1685, Louis XIV., who on matters of religious faith did not allow of a difference of opinion, revoked the Edict of Nantes. In their choice of apostacy or exile, the French Protestants did not hesitate. Five hundred thousand of them took refuge, some in Switzerland, some in Germany, some in Holland, and some in England. They were the flower of the country in eminent manufacturers, talented artists and skilled workmen. They endowed their adopted country with processes unknown to the inhabitants, instructed them in the newest discoveries, and established important manufactures, which soon enjoyed a remarkable success. This is the origin of the eminent Watch manufacture of Geneva, Neufchatel, Harlem, Amsterdam, and London.

It is from this unfortunate period that we are to date that superiority in England which is to last through several generations. At the death of the great king affairs are so entirely altered that the regent D'Orleans, a great amateur of Horology, desirous of seeing it flourish in its former splendour, invited at great cost several eminent Horologists from London. These were Loiseau, Calvert, and chief of all, John Sully, These men were the sons of three French watchmakers exiled from France thirty years before. Established in Paris under the immediate protection of the Regent, patronized by the court and city, these practical men were not long in recovering the interrupted progress of the manufacture, and in giving to it the active impulse of improvement.

We now come to an advanced period of the eighteenth century to the middle of the profligate reign of Louis XV. This was an

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era of extraordinary talent. In the first rank appears Julien Le Roy, the founder of a dynasty of celebrated watchmakers, perpetuated by his four descendants during more than a century, and represented in our time by the house of Le Roy and Son of Paris and London.

Julien skilfully modified the English repeating watch, and perfected the mechanism of the horizontal watch. His inventions were adopted by all Europe. Specially distinguished by Louis XV., and sumptuously established at the Palace of the Louvre, it was of this artist that Voltaire said after the battle of Fontenoy, and speaking to his son Pierre—"Sir, your father and Marshal Saxe have triumphed over England." From this period may be dated the decline of British Horology from the foremost rank to that position in the world's estimation which it holds in our day.

Julien Le Roy had all the honors, even that of fraudulent imitation. The Swiss who had already opened a large trade in export to the East and West Indies, did not hesitate to engrave in their best watches the name of the celebrated Paris maker.

Pierre Le Roy surpassed his father by the extent of his theoretical and practical knowledge, as well as by the importance of his discoveries. In 1748 he invented the duplex escapement, which, duly appreciated and carefully executed in London, contributed much to extend the reputation of British watchmaking. He was the first in France to construct valuable marine chronometers, able to determine the longitude at sea. Notwithstanding, Pierre Le Roy did not feel completely satisfied with the duplex. He experimented and discovered the spring detent escapement, which will not bear his name, but that of Arnold an English watchmaker and author of some details in modification. The discovery of a new mode of compensation, and the isochronous vibrations of the balance in a certain length of the timing spring, add the crowning work to his labours. Horology for perfect timekeeping is to be found altogether in the chronometer escapement, compensation, and isochronism. At this epoch of the art, Horology has reached perfection. Voltaire himself assisted in its progress by establishing at the little village of Ferney, situated about a league from Geneva, but on French soil, an important manufacture, where flat watches were first produced. The Patriarch of Ferney, in one of his refined communications, thus speaks of it:—At my place here, better watches than are made in Geneva are produced, and the Sieur Lepine, the king's watchmaker, has his establishment and workmen among us. We manufacture for Paris and for Bengal. * * * Our productions are rendered at half the cost of the London watches. Our repeaters would sell for thirty Louis at Paris—you may have them at Ferney for eighteen—Send me your orders, you shall be supplied, you shall have very fine watches and very indifferent verses whenever you may please to send for them.

After the death of Voltaire the factory at Ferney fell away in a few years. Its numerous and clever staff were dispersed to Geneva, Locle, Neufchatel, and Chaux de Fonds, to the great benefit of these localities, and the serious disadvantage of France.

Well versed in mechanical science, Louis XVI. was much given to Horology, but he did little for the encouragement of artists, and did nothing to reform the ill contrived regulations, and the restricted duties which hampered the expansion of French commercial transactions. The Revolution coming, involved everything, carrying all before it. Absorbed in the empire, Geneva and Neufchatel followed the destinies, both political and industrial, of France during that period. Paris maintains its pre-eminence in the art, supported by the Le Roys, Berthouds, Breguets, Lepautes, Wagners, and Houdins. The great traditions of the eighteenth century survive. The chronometric department of the art is perfect. In addition, it has extended its influence by the requirements of electric apparatus. However, no great discovery signalizes the first half of the nineteenth century. The hour of time has marked for France a period of adversity. 1814 is the fatal period of the break up of the empire. 1815 bringing with it the treaties of Vienna, reconstitutes Europe geographically and politically. Then from being French, which it really was, the Geneva watch manufacture became a formidable foreign rival. But the persevering and mercantile genius of its manufacturers, aided it less than the unfortunate fiscal arrangements adopted by the Restoration. The Swiss manufacture owes its success in great part, during the period between 1817 and 1851, to Mr. Saint Crecy and the legislative defenders of his doctrines. Great credit is however due to it for persistent efforts to distribute its productions over the world, in multiplying its establishments and its agents in Europe, America, India, and China. The Geneva houses have numerous representatives in London, whence they export to all the English colonies, and to the utmost limits of the East.

In 1861, they dispatched two clever agents to Japan, specially to open a trade with that remote country.

The energy and spirit of initiative of the Swiss prevail in a direct and absolute way over the apathy and unenterprising character of the French manufacturers; these generally limit themselves to local trade, paying but little attention to foreign connexion; while the Swiss display extraordinary activity in maintaining their eminent reputation abroad, and in opening new markets in every country of the globe. For twenty branches of Swiss houses established in England, but one French house exists in London, that of Leroy and Son. Out of 100 watches sold in the United Kingdom, not more than ten can be said to be of French manufacture. If, however, we can rely upon numerous documents and careful inquiries derived from authoritative sources, as well in England as on the continent, the Swiss will be seriously menaced in the market of cheap manufacture.

As to British manufacture, vitally affected since the peace of 1815, it seems to have reached a period of almost complete decadence.

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Let us demonstrate this by seriously examining the commercial question properly so called, and in establishing the comparative situation of French, English, and Swiss Horology in 1863.

III.

The Exhibition of Paris in 1855 differed little as to general results from that held in London four years previously. At the International Exhibition of 1862, French Horology had lost nothing of its perfect finish, while in a commercial point of view a marked progress was established.

But the case in which the Paris productions were shown was anything but to be proud of. Whether from indifference on the part of exhibitors, or want of agreement among themselves, whether from parsimony, or deficient taste in the producers of the glass cases, the French horological display was remarkable for the absence of all rich ornament, as well as methodical arrangement, giving it too much the appearance of a stall at the Leipsic and Beaucaire fairs.

To take a rapid glance at the remarkable specimens of this Exhibition.

The first name on the catalogue is that of historical reputation, Le Roy & Son, of Paris and London. Among other extraordinary productions shown by this house, their astronomical regulators were much admired, one of which, a real wonder of mechanism, seemed to be the last result of horological skill. It showed the days of the week, the days of the month, the phases of the moon, mean, and real time. It beat both half and whole seconds with a compensation pendulum of 18 inches in length. It was furnished, in addition, with a metallic barometer and two thermometers, all perfectly distinct and shown upon separate dials. Among many watches of superb execution, one showed a complication apparently extraordinary; being in fact the regulator reduced in bulk to a portable form, with a barometer, perpetual calendar, showing the days of the week, month, phases of the moon, beating seconds, quarter and half-seconds. The centre principal seconds hand is double for observation, and acts by pressure at the pendant knob. At the first pressure one hand stops, at the second both stop, while the third unites them as one, causing them to move forward as at first. This watch, the size of an ordinary repeater, strikes the hours, quarters, and minutes, and is keyless, winding up at the pendant.

The carriage clocks of Messrs. Le Roy, to which they have adapted a calendar of their own invention, are distinguished for their elegance and finish, and have obtained a decided success in England. This house is the only one, as already stated, which has presumed to plant the standard of French watchmaking in London; to raise an altar beside the national one, and enter into direct competition with our rivals on the other side the channel.

Success has crowned this hardy attempt, and the special appointment of the house—"Watchmakers to the Queen,"—indicates the high rank it holds among the practical watchmakers of the United Kingdom. Another celebrated name among watchmakers is that of M. Breguet. Calendar clocks, marine chronometers, indicators and repeaters, prove by their high class execution that this family has not degenerated in the person of its representative.

But the influence of the celebrated Breguet in devoting himself to the construction of telegraphic instruments,—a speciality in which he has taken the foremost rank,—seems to us to have done little to aggrandize the ancient and brilliant reputation of his house in the domain of Horology, properly considered.

M. Redier, of Paris, is an horologist of merit, and an eminently practical man, who specially devotes his attention to the production of articles accessible to the million. His seconds' indicators are very ingenious, his alarums exhibit a great variety of form, he is a persevering producer, and an enterprising exporter to foreign markets, such as the French manufacture has too few to boast of.

Mr. Vissiere, of Havre, had some very perfect chronometers. The carriage clocks of M. Drocourt deserve particular mention for their excellence. The same may be said of the regulators and perpetual calendars of Mr. Brocot, whose father discovered the striking rack, an invention now made public and in most general use. Mr. H. Robert, one of the most skilful practical horologists, had exhibited but one highly finished indicator.

In this naturally very brief retrospective review, we have to signalize collective exhibitions and to indicate the statistics of French horological manufacture as it exists with reference to its foreign trade. Independently of Paris, the focus for costly instruments, is Havre, where excellent marine chronometers are manufactured. Four great watchmaking establishments exist at Besançon, in the department of Doubs, at Cluse in Upper Savoy, at Beaumont in the Upper Rhine, and at Nicholas d'Aliermont, Seine Inférieure. In the year II. of the Republic, the Swiss patriots of Neufchatel, to the number of 1600 sought refuge at Besançon. The richest and most enterprising of these emigrants were M.M. Savoye, Courvoisier, Favre, Hugenin, Janneret, Mathey, &c., &c., who all settled and laid the foundation of a redoubtable competition with the Swiss manufacture. However, under the influence of general causes, indicated previously, the Bysontine manufacture progressed but slowly during the first half of the present century. Besides this the Swiss colony, although naturalized French, reckoned but Protestant. Established in a centre, essentially Roman Catholic, it recruited with difficulty its workmen in the locality. But this isolation ceased from 1848, and from this period its workshops were opened to a numerous and intelligent young community, and while the Swiss extended more and more their foreign trade, sacrificing to an equal extent perfection of workmanship to cheaper markets; a contrary practice was followed out at Besançon where they had to satisfy the more exacting requirements of a French connexion. The result is easily divined. Geneva largely increased its export manufacture, but gradually lost its reputation for high class work. On the contrary its rival enjoyed a reputation at the period when

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economic changes effected under the empire allowed it to take its place in foreign makets. A few statistics will suffice to show the progress made. In 1849, Besançon produced 38,598 silver and 6,149 gold watches. Thirteen years after, that is to say in 1862, the manufacture increased to 100,000 gold and 300,000 silver watches annually. Feeling itself powerful at home, the Franche Comtoise industry extended the area of its transactions. Now it exports to Belgium, Italy, Spain, and England. The transatlantic markets will be opened to it with very little effort, if its manufacturers exhibit the spirit of initiative shown by Messrs. Savoye, Brothers, of Besançon and Paris, whose trade with London shows a notable extension. The united exhibition of the Bysontins offered a fine collection of first and second class watches, of splendid repeaters of excellent workmanship, and at a price no higher than the common sort of Swiss watches. Strange to relate, Geneva is a purchaser of movements from Franche Comté, also of cylinders, balances, and other accessories to the watch, all articles which it could not produce so cheaply. In fact Besançon, the centre of a manufacture of excellent watches, produces silver watches as low as 16 francs. This is a cheap market which the the Swiss, with all their enormous export trade, cannot rival. Before the annexation of Savoy to the French empire, Cluse had scarcely any trade with Geneva. This small centre of watch manufacture, where the artisans work only in the winter time, (devoting the summer time to agriculture), continues to supply Swiss manufacturers with movements, and that to a considerable amount.

Further, the conditions of the cheapest possible manufacture are realized at Beaumont by Messrs. Jappy, Brothers. Every year, from the workshops of this firm, clock movements to an enormous amount are sent out, and at a price that no foreign competition can equal.

St. Nicolas contains a population of 3000 watchmakers, and its production extends from regulators, chronometers, and expensive clocks, to small timepiece movements and watch tools. The principal manufacturers are M. M. Pons, Jacob, Dumas, Schurf, and Martin. Paris takes a large portion of its movements from St. Nicolas.

Such is the position of French Horology at the present time, an advantageous one when compared with its rivals of Switzerland and England. The former, always great by its reputation, and powerful by its large foreign trade, finds itself unfortunately compelled to exaggerate its productions, to sacrifice excellence to general trade, and to push into remote and speculative markets. As to the latter, vitally affected long since by the Geneva trade, she is scarcely sustained by her old renown, and by the patriotic efforts of her producers.

We have observed the art of Horology assuming a vigorous growth in Great Britain, at the period of the French Huguenot immigration in 1685, '86, and '87, painfully maintaining its ground against the competition of the Le Roy and their pupils, flourishing again during the period of the Republic and the Empire, then falling in our time to a mere tributary to Swiss manufacture. At the present time, one branch only remains as its undisputed prerogative. A maritime nation before everything, the British people must preserve, at all cost, that special department of the art most in demand with it. Munificent rewards voted by Parliament, and by Scientific Societies, have upheld the highest class of horological productions to an eminent degree. Their marine chronometers, under an ordinary exterior, and without the least attempt at tasteful ornament, worthily uphold their ancient superiority. In France, a highly executed piece of horological mechanism will not pass muster without an expensive case, elegantly ornamented. The practical good sense of the English makes them prefer a perfect instrument of the simplest form to the richest gem. On this account, London produces its chronometers at a much lower price than those of Paris; but after that nothing more can be said. Limited to the groove of a routine practice, this manufacture has never varied its forms nor modified its models for the last sixty years. This respect for tradition has been of little service. Liverpool, which formerly manufactured largely for national consumption as well as for export, has done nothing worth mentioning for the last ten years. At this time this populous city can boast of but one case maker. Coventry, at one time the St. Nicolas and the Beaumont of Great Britain, produced an immense quantity of cheap watches. Its production declines gradually before the invading competition of Besançon. To come to the special manufacture of London. Here our embarrassment is considerable, for if we utter the naked truth, our frankness will doubtless rouse the patriotic indignation of the English producers, small and great. Already, indeed for the statement last year of the names of French artists to the choicest productions of porcelain, we have been taken to task and vehemently accused of mis-statement, misrepresentation, and ignorance. At the risk of similar accusations we still state what the most careful researches, the most active and painstaking investigations have revealed to us. The English watch, *sui generis*, is scarcely more than a *myth*, an extraordinary exception. Foreign workmen only produce keyless watches and repeaters of the first class which are sold with the name and mark of the first houses in the English trade. This assertion made, let us produce the proof and give the names of the Foreign artists. The finest cases to English watches are due to Swiss workmen, the principal of whom are Stram and Loup, Gaulet a Genevese, and Lecluse a Frenchman, have a manufacture which consists of gilding Swiss movements, fitting them up in English cases, dials and hands. The finished watch bearing the English stamp is sold as a national production.

Guiblet, a Frenchman, produce splendid watches for the first houses, such as the firms of Dent and Frodsham. The Brothers Guillaume do the same; Nicole and Capt, Genevese, the inventors of keyless watches with the going barrel movement, contracted with the first Dent

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to supply him exclusively with this kind of watch which they published as their own invention, under the name of Patent Keyless Watches. But in England, the public—excepting the watchmakers—is perfectly satisfied that Dent invented this handsome winder.

Noyer, a Frenchman of intelligence beyond the common, perfected and applied this winder to English Fuzee Watches. Dent monopolised this speciality by an agreement. Now Noyer since then has manufactured for the London watchmakers his superb watches.

Kullberg, a Swede, produces splendid marine and pocket chronometers. We are informed that he was the maker of the finest production of this kind at the last Exhibition and its chronometric chef d'œuvre; but this statement we do not guarantee. A considerable number of foreign artisans work for houses of the third class, and for the export trade. They help to maintain a principle of vitality in British watch manufacture, which, without their intelligent support, would soon cease to exist. The question remains to be asked—Why do they not employ their talent in Geneva, Besançon, or Paris? The answer is altogether a matter of stipend.

A simple watch, made by Noyer and sold by Dent, costs £50. sterling; at Paris or Geneva the same watch would scarcely sell for two-thirds that sum.

Now for this same watch, with a French or Swiss character, an Englishman would never pay this price for. But once its heavy and clumsy case bears the national mark, when its hands, figures, and dial bear the worn out form of the last century, the patriotic purchaser does not hesitate.

Has he not been assured that this excellent piece of mechanism is a *genuine* production and British to its smallest details? That at once makes it worth 12 or 15 pounds more.

In this treatise, condensed as much as it could be, we have not been less precise as to the technical than to the historical characteristics of the art of Horology,—to the extent that the materials for an opinion, documents and manufacturing statistics revealed to us, enable us to come to a conclusion: one fact seems clear—it is this:—That of the three great centres of watchmaking, one exists only in name, the other has arrested its decline only by prodigious mercantile efforts, while the third combines in itself the qualifications of youth and maturity of intelligence and power. With little effort France might again wield the sceptre of this wonderful art, which owes its most valuable discoveries and greatest improvements to her sons. What is required for French horology in these days, to aggrandize its position and establish its supremacy in the world? Not a greater scientific eminence, which was, is still and always will be, the National feature, but a greater commercial spirit, a more initiating enterprize; in fact, more of that resolute determination to open foreign markets, which distinguishes in so high a measure the Swiss and English manufacture. The object is sufficiently vast to tempt the ambition of her practical men, and the aim remunerative enough to satisfy the aspirations of her most important manufacturers.

JOHN WILKS.

See *Constitutionnel*.

[In publishing this translation, by one of our members, of an article which recently appeared in the *Constitutionnel* under the pseudonym of John Wilks, we in no way endorse most of the writer's conclusions, as it would be easy to prove, we think, that the Paris manufacture of watches and chronometers, will bear no comparison in point of quantity with that of London, and this we think statistics in our present Journal will abundantly prove.—*Vide* report Coventry Watchmakers' Association.—In this otherwise interesting sketch of horology, and review of the Swiss, French and English manufacture, the writer's patriotism, we may say egotism, has much of a trade advertisement character about it. He complacently ignores some of the most important inventions due to English mechanical genius. To say nothing of others, we may cite the horizontal escapement of Graham, universally adopted in Switzerland and France, the chronometer escapement as perfected by Earnshaw, and not least, the invention of Mudge, the Lever escapement.

The statistics of the Besançon trade, showing its importance and great prosperity in the watch manufacture may be new, and will be of interest to our readers, while the omission of all mention of a place hitherto associated with sound British watchmaking —Clerkenwell—would vitiate any comparative review, did it not render it amusing. We are told on excellent authority, "It is good to see ourselves as others see us," still more when in doing so, we are enabled to appreciate features in the otherwise undisputed merit of our neighbours, which may previously have escaped notice.]

STRICTURES ON THE ENGLISH LEVER.

By ROBERT HOPWOOD.

IT is to be regretted that English watch manufacture is so much a matter of pounds, shillings, and pence, that excellence in art is for the most part overlooked in the desire of gain. The mass of our makers have been dragging on in the conventional ruts till there are signs of their being behind the age, and the gravest apprehensions may be entertained as to the future of this branch of industry. We may remark that *popularly* the French clock has deservedly superseded the English, and there are significant symptoms that the English watch *is* losing ground in public estimation, both at home and abroad.

In America (hitherto the great receiving house for *all* the flashy rubbish we choose to send), MACHINERY is telling its tale; and it will not do to pooh pooh the facts,

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or to put off the evil day, unless it be by such means as will enable us to hold our own.

If the English lever is to continue in demand, *it must* be remodelled—movement to case—to enable it to do so. The movement is antiquated in its calliper, disproportionate in its guagings, and generally unscientific and homely (thanks to the unintelligent division of labour).

The machine as a whole is unworthy of the age, and of the *capacity* of English workmen. These are the reasons why the English watch is losing its once high character.

It will now, perhaps, be asked, What remedies are to be suggested after such denunciations?

The first is, *Better raw material* for the "movement." A fine quality of hard-hammered brass, the chemical and mechanical conditions of which shall be well calculated for the purpose in hand. Secondly, *a reconstruction* of the "movement" itself: —always feeling after severe simplicity, and substantial style; avoiding whimsical gallicisms, in doing which we propose the absolute *disuse* of the fusee, with all its paraphanalia, and the *adoption* of the going-barrel instead, as large as it can reasonably be made, with a long, thin mainspring; the click work to be independent of the barrel arbor, and the stop work on the under side. Here is scope afforded to the inventor of bringing out a really useful winding apparatus, so as to render the watch "keyless;" but it must be such as will deserve a better cognomen than that of "an ingenious toy."

Our next concern should be to determine the best possible standard of relative proportion in the sizing of the wheels and pinions of the train. This is a matter which, under our present system, is left entirely to the tender mercies of the movement maker, and its correctness taken for granted. What wonder then if error be a general thing.

The escapement, as a rule, is too large to be well proportioned to the sizes of the barrel and train. Hence we generally find a small barrel containing a short, stubborn mainspring,—too short to be capable of adjustment, *toiling through its labour*, and generally breaking after a comparatively short service.

It is well known that in the lever escapement there is a large amount of friction; it is nevertheless capable of a great deal. It would be improved by, first, *a steel 'scape wheel.* Second, a roller, made as thin as possible, with a small brass or steel plug rivetted in, and drilled through for the ruby pin. Third, careful poising of the balance with the roller on; also of the lever and pallets. The rule being that the point of gravity to the axis shall be co-incident in both cases, or as near as can possibly be.

The notch or fork of the lever should also be made very thin, and the planes of contact with the ruby pin well rounded and polished so as to exact a minimum of friction in the "roller depths."

Scrupulous attention to these minute details would essentially affect the going qualities of the watch. They are not advanced as *new*, but simply *pointed out* as things commonly overlooked.

The balance (not compensated) should be made of very dense brass, hard hammered aluminium bronze, or gold, as heavy as is now used, but of smaller dimensions.

A movement such as we desire to see brought out would not require a case with more than one joint, which might be made very strong, and *almost* watertight, if not perfectly so.

We propose, therefore, that instead of the narrow ledge at present in use, a wide ledge should be left, grooved and fitted with an india-rubber washer for the main plate of the movement to be screwed down upon, the dial to be screwed on afterwards By this means the bezzle would shut down perfectly flush.

A strong glass, cemented in with varnish, would complete the best model watch for use in India, at sea, and for general use too. The nearest approach to this model we have yet seen is found in what are commonly known as "German levers."

A foolish pride should not prevent us from endeavouring to combine all the best ideas of the Switzer or Dutchman, and uniting them to produce a thoroughly English embodiment of them with our own. We hope to see it done while there is room in the market for such an article.

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METEOROLOGICAL OBSERVATIONS,
Taken at 9 A.M., OCTOBER, 1863.
11, *Offord Road, N.*

Day of the Month.	Barometer, at 32° F, and mean sea level	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9A.M.	During the next 24 hours
	inches.	°	°	°	°				
1	29·296	55	53	60	48	WSW	4	cb	rq, o
2	·761	52	48	60	48	W	4	o	oq, or
3	·894	58	56	58	50	WSW	7	or	o
4	·922	63	61	63	57	SW	8	o	pq, o
5	30·050	49	47	65	43	NW	1	m	r, o
6	·005	46	42	58	39	NNW	2	bc	o, mr
7	29·748	54	52	61	42	E	1	om	omr, bc
8	·627	60	58	61	51	E	4	bc	omrq
9	·632	53	50	65	51·5	ESE	3	or	omr
10	·693	59	56	59	49	SSE	3	bc	oq
11	·592	56	53	62	53	SW	8	c	q, cb
12	·545	55	52	62	49·5	SSE	2	c	c, o, r,
13	·340	55	52	63	50	SSE	4	o	r, o, r,
14	·587	56	52	56	51	SSW	7	cb	cb
15	·647	54	53	65	50	SE	2	mr	rr, o
16	·827	52	49	57	49	SW	4	c	cb, r
17	·966	56	53	63	50	W	4	cb	cb, f
18	30·066	57	54	65	49	SW	5	o	oq, mr
19	·093	57	55	61	54	SW	7	o	o
20	·070	57	55	61	54	WSW	3	o	o, r
21	·200	54	52·5	59	49	E	1	om	om
22	·134	56	54	57	51	W	3	o	bc, bm
23	·280	49	46	63	45	W	2	bc	b, m
24	·297	40	38	59	36	N	1	m	b
25	·077	48	45	53	38	W	4	bc	bcm
26	·077	42	39	57	39	ENE	2	bm	bc, b
27	·010	41·5	40	58	38	Calm	0	f	f, m
28	29·693	52	49	52	41	SSW	2	om	r, bm
29	·482	49	47	55	45·5	SSW	4	or	rr, oq
30	·427	51	49	54	44	SSW	7	o	qqrrh, bc
31	·516	46	42	53	40	SW	9	b	bcg
	29·824	52·7	50·1	59·5	46·9		3·8	Mean.	

REMARKS.

The atmospheric pressure attained to 30·34 inches of mercury at 8 p.m., 23rd, and diminished to 28·946 at 3½ p.m, 30th; hence the extreme range was 1·394 inches. The barometer gave 29·23 at 2 p.m., 1st; 30·05 at 8 a.m., 5th; 29·32 at noon, 13th.

Gales from S.W. to W., and from S.W. to N.W. prevailed on the 2nd and 4th.

During the 30th and 31st a strong gale blew from S. to N.W. Between 3 and 4 p.m., 30th, it was most furious, with heavy rain and hail, and did much destruction in the southern part of the metropolis.

Between the 6th and 11th the wind veered from W. to N., E. to S.W.

Rain fell on 18 days, during about 72 hours, to the amount of 1·58 inches.

According to the table, the wind blew from the N, on 2 days; E, 6; S, 10; W, 12; and there was one calm day.

There was an extreme range of the barometric column, and a deficiency of rain, otherwise the month exhibited its usual characteristics, for the averages of the barometer, and thermometers, as well as the prevalent direction and character of the wind, agree very closely with the indications of the general weather of the month, (vide p. 143, vol. V.)

EQUATION OF TIME TABLE.
For December, 1863.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *subtracted* from added to Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *added* to deducted from Mean Time.
		m. s.	s.	m. s.
Tues . .	1	10 51.74	0.935	10 51.57
Wed . .	2	10 28.97	0.962	10 28.80
Thurs .	3	10 5.55	0.989	10 5.38
Fri . . .	4	9 41.50	1.015	9 41.34
Sat . . .	5	9 16.85	1.039	9 16.69
Sun . .	6	8 51.64	1.062	8 51.48
Mon . .	7	8 25.88	1.084	8 25.73
Tues . .	8	7 59.60	1.105	7 59.45
Wed . .	9	7 32.84	1.125	7 32.70
Thur . .	10	7 5.62	1.143	7 5.49
Fri . . .	11	6 37.98	1.159	6 37.87
Sat . . .	12	6 9.98	1.174	6 9.86
Sun. . .	13	5 41.63	1.188	5 41.52
Mon . .	14	5 12.96	1.200	5 12.86
Tues . .	15	4 44.01	1.211	4 43.92
Wed . .	16	4 14.82	1.220	4 14.74
Thurs .	17	3 45.43	1.228	3 45.35
Fri . . .	18	3 15.86	1.235	3 15.79
Sat . . .	19	2 46.16	1.240	2 46.10
Sun . .	20	2 16.36	1.243	2 16.31
Mon . .	21	1 46.48	1.245	1 46.44
Tues . .	22	1 16.56	1.246	1 16.54
Wed . .	23	0 46.65	1.246	0 46.63
Thurs .	24	0 16.74	1.245	0 16.73
Fri . . .	25	0 13.12	1.242	0 13.12
Sat . . .	26	0 42.90	1.238	0 42.89
Sun . .	27	1 12.56	1.233	1 12.54
Mon . .	28	1 42.09	1.227	1 42.06
Tues . .	29	2 11.44	1.219	2 11.40
Wed . .	30	2 40.59	1.210	2 40.54
Thurs .	31	3 9.51	1.200	3 9.45

ERRATUM.

In the "Rates of Chronometers on Trial for Purchase by the Board of Admiralty" 1863:—

Page 4. Chronometer Reynoldson, 7245, Rate for the Week, March 28 to April 4, *for* −26ˢ·4, *read* +26ˢ·4.

Royal Observatory, Greenwich,
1863, *October* 24.

All Communications for this Journal should be addressed to the EDITOR, *at the Office*, 35, Northampton Square, Clerkenwell.

Our pages are at all times open to correspondence and contributions, either original or compiled from good authorities; but the contributors are alone responsible for their own opinions.

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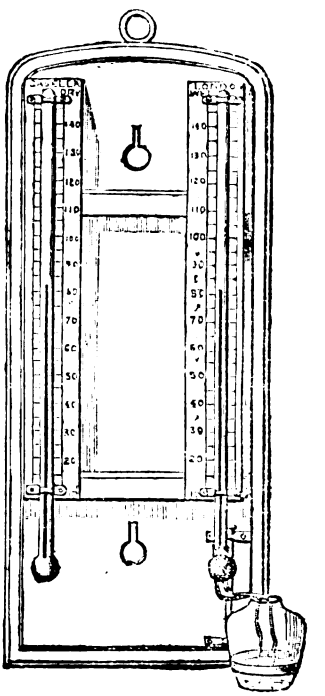
CASELLA'S WEATHER INDICATORS.

THE INSTRUMENTS essential for forming a scientific judgment of the impending weather are a BAROMETER and a HYGROMETER. The Barometer alone is not a sufficient exponent of the coming atmospheric changes. To foretell rain, we require the means for ascertaining the state of humidity of the air; and, to anticipate the veering and strength of the wind, we should know the march of atmospheric temperature, in addition to the indications of the Barometer. Both the temperature and the humidity are shown by the Hygrometer.

Admiral Fitz Roy, in his various Meteorological papers, has shown the necessity of consulting the Hygrometer, as well as the Barometer, in forecasting weather,—and, indeed the success of his forecasts of the weather, more especially of his forewarning and signalling of storms and gales, are evidences of the correctness of his views. The Admiral's labours have been of immense service to the maritime portion of the community, and those interested in sea risks.



DESCRIPTION OF THE INSTRUMENTS.

The *Barometer* is a glass tube containing mercury, dipping into a covered cistern partially filled with the same fluid, and mounted on an oak frame. At the upper end of the tube is placed a thermometer, scale-plates, and a sliding vernier. The scale and vernier enable the height at which the mercury stands in the tube to be measured to the nearest hundredth of an inch, and Admiral Fitz Roy's formula for interpreting barometer indications is engraved on the scale. The thermometer is for ascertaining the temperature of the mercury, its scale showing distinctly each degree. The scale-plates are ivory, engraved so as to admit of cleaning without any detriment, and there is a screw at the bottom of the instrument for the purpose of making it portable.

The *Hygrometer* consists of two thermometers, exactly similar, mounted side by side on a porcelain slab, upon which the divisions and words are engraved, and permanently burnt in, so that they cannot be obliterated by any length of exposure to the weather, and may be cleaned like ordinary porcelain. The bulb of one thermometer is covered with a piece of muslin, from which a few inches of lamp cotton trail. Below this bulb, on the wooden support of the instrument, is fitted a small cup, to contain fresh water, and in which the end of the lamp cotton must be immersed. Thus arranged, the water will rise by capillary attraction to the bulb, and keep it always moist. This is called the Wet Bulb. The other thermometer is quite exposed, and is termed the Dry Bulb. Evaporation, more or less rapid according to the state of the weather, will take place from the wet bulb, and will always cause that thermometer to read lower than the dry thermometer, which shows the temperature of the air itself.

INSTRUCTIONS.

The Barometer should be placed out of the reach of sunshine. When first fixed in its place, the screw at the bottom should be unscrewed to its limit—by which means the mercury will descend so as to act correctly. After this it should not again be touched, until the barometer is to be removed. Then the screw should be turned so as to raise the mercury to the top of the tube to make the instrument portable. The barometer is intended to be placed in the house. The Hygrometer, however, must be exposed as completely as possible to the free influence of the external air, taking care that it is as much as possible in the shade, and unaffected by radiation of the sun's heat. The cup must be kept supplied with pure water, and occasionally cleaned. The muslin and cotton should be changed once a month. Muslin may be dispensed with under good management, by simply tying the cotton wick loosely round the neck of the bulb, then

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thoroughly wetting it and plunging the two ends into the water. Thus arranged, a good cotton wick will supply sufficient water to keep the bulb moist—it should not be too wet, so as to cause water to drop. Careful attention to these directions will ensure accuracy in the indications.

HOW TO USE THE INSTRUMENTS.

It would be advisable to take observations twice daily, say at 9 a.m. and 3 p.m., and to record them on some familiar or easy method to which the observer may be accustomed, or on a registering form just published by L. CASELLA, for that purpose.

Having read the attached thermometer, and noted the temperature, then read the barometer.

When observations are taken with a view to publicity or for comparison with those taken at the various stations of the Board of Trade and published daily in the newspapers, they should be reduced to the freezing temperature and sea level by the two following rules :—

1st.—For each thirty degrees of temperature above 32°, *subtract* one-tenth of an inch.

2nd.—For each hundred feet above the sea, *add* one-tenth of an inch to the barometer reading.

The Hygrometer should next be read, each thermometer being noted to the nearest half degree. Take the difference between the two readings, that of the dry bulb and that of the wet bulb. This difference is indicative of the dryness or dampness of the air, the greater the difference the more perfect the dryness; if there should be little or no difference, the air will be as damp as it can be.

Having made the observations, we have to ask ourselves, what weather may be expected from the indications.

To enable an answer to be formed, we should go back to the observations of the previous day, or two days. Suppose, then, that only morning observations are recorded, and that yesterday barometer was 29·96 inches, dry bulb 61°, wet bulb 54°, wind W., light, fine; while to-day barometer is 29·70, dry bulb 62°, wet bulb 58°, wind S., light, fine. Here the barometer column has fallen, the air has become moister, there being a difference of 7° yesterday, but only 4° to-day. Further, the wind is in the rainy quarter; rain may therefore be confidently anticipated, although the weather is now fine, in the course of the day—but not much change of wind.

We will propose another case. Yesterday 29·53, 51°, 50°, S., strong, rain. To-day 29·99, 42°, 40°, W., light, haze. Here the column has risen, the air has become colder and drier, while the wind has gone down, and the rain has ceased. Hence dry, fine, but cold weather may be expected, with wind veering to northward.

Again, we observe 30·37, 40°, 38°, N.N.E., light, hazy, fine; and on looking back we find everything has been much the same for the previous two days; we anticipate, therefore, that the same weather will continue.

After a few weeks' practice the observer will begin to be expert and reliable in the conclusion at which he arrives, from such consultation with facts. Of course atmospheric appearances, as well as the peculiarities of the month or season, should be duly considered.

The following table will greatly assist in familiarizing the inexperienced with the value of the Hygrometer indications :—

DRY BULB	DIFFERENCES OF DRY AND WET BULBS.						DRY BULB	DIFFERENCES OF DRY AND WET BULBS.					
	2°	4°	6°	8°	10°	12°		2°	4°	6°	8°	10°	12°
34°	79	63	—	—	—	—	58°	87	76	66	57	49	—
36	82	66	53	—	—	—	60	88	76	66	58	50	43
38	83	68	56	45	—	—	62	88	77	67	58	50	44
40	84	70	58	47	—	—	64	88	77	67	59	51	45
42	84	71	59	49	—	—	66	88	78	68	60	52	45
44	85	72	60	50	—	—	68	88	78	68	60	52	46
46	86	73	61	51	—	—	70	88	78	69	61	53	47
48	86	73	62	52	44	—	72	89	79	69	61	54	48
50	86	74	63	53	45	—	74	89	79	70	62	55	48
52	86	74	64	54	46	—	76	89	79	71	63	55	49
54	86	74	64	55	47	—	78	89	79	71	63	56	50
56	87	75	65	56	48	—	80	90	80	71	63	56	50

Representing by 100 the total quantity of vapour which the air at any temperature can hold in suspension, the percentage of vapour actually present at any time may be found in the table opposite the temperature of the dry bulb thermometer, and under the difference of the dry and wet bulb readings. The percentage corresponding to intermediate degrees and differences, not given in the table, can be readily inferred. Thus, air temperature being 63°, and difference 5°, the humidity of the air would be about 72.

In the British Isles the Hygrometer very seldom shows a greater difference than 12°, hence it is presumed that the table will be of much practical utility. Below freezing, 32°, the observations of the Hygrometer are uncertain; but then they are not of so much importance, since the state of the air is known to be dry.

If the difference between the dry and the wet bulb readings be taken from the reading of the wet bulb, the remainder will be the temperature of the dew-point, very nearly. This simple rule

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will be found of much service to the horticulturist, since it will enable him to estimate the chilling effect of dew, or hoar frost, upon tender plants; or even to anticipate its deposition, and guard against its effects.

RULES FOR FORETELLING WEATHER BY CASELLA'S NEW WEATHER INDICATOR.

1. When the Barometer is *steady*, at or about its mean height (29·90 at the sea level, less as we ascend), with a seasonable temperature, and dry air, the weather will probably continue very fine.
2. If it *rise* from this point, decidedly fine, dry, and perhaps cold weather will follow.
3. If it *fall* two or three tenths below the mean height, rain or stronger wind will happen. If the Hygrometer shows increasing moisture, rain will be more probable.
4. A gradual rise or fall indicates less immediate change than sudden fluctuations.
5. The barometer attains and maintains its *highest* elevation with north-easterly winds, which bring generally clear but cold weather. It is generally high with fogs, calms, or frosts.
6. The mercury falls *lowest* for violent winds and heavy squalls, not necessarily with rain, which, however, should be anticipated if the wind is from between the S. and W., or if the Hygrometer shows increasing moisture.
7. A rapid rise, or unsettled motion of the mercury, after it has been very low, foretells unsettled or changeable weather.
8. In winter a fall, with cold increasing, foretells snow; but a fall during a frost, indicates a probable thaw.
9. A fall, with calm or very warm weather, indicates rain with squally weather.
10. In forming a judgment of forthcoming weather, the point at which the mercury stands should not be so much regarded as whether it is rising or falling, and much consideration should habitually be given to its movements during the previous two or three days.

Those who desire to become further weather wise, should consult Admiral Fitz Roy's "Barometer Manual."

PRACTICAL EXPERIENCE ON THE EFFECTS OF OIL.

In 1778 Robin wrote as follows on this subject:—"The supplementary forces required by a train of wheels are not the sole causes of varying friction. Oil, although indispensable to horological machinery, becomes one of its greatest drawbacks from the difficulty of obtaining it of suitable quality.

"Till chemistry shall reveal to us a lubricating fluid, permanently limpid, we shall continue to employ the purest olive oil, and to preserve it for the longest possible period in its natural condition.

"The treatises of M. Sully have clearly shown the utility of the oil-sink, but the proper shape and quality should be carefully observed. The dried green powder which is left cuts and destroys both hole and pivot, whence arises obstruction at the pivots and in the depths by the wheels being put out of truth, and which ends by altering the action altogether. The natural quality of the metal itself is to form verdigris without the added influence of acids. It only requires the oil to be not pure to increase this considerably.

"*Shape of the Oil-sink.*—It is necessary to make this sink of such a shape that it will hold the greatest quantity of oil the longest possible time. This shape is the half of a hollow sphere, finishing by a square border to prevent the oil spreading to parts where it may be as injurious as it is useful at the pivots. The *centre* may be schamfered to facilitate the introduction of the oil to the pivot.

"*Condition of the sink.*—It should be made smooth, and then *well polished with hard wood* charged with rouge or rottenstone and oil, and rubbed long enough, not only to polish it, but to stop all the pores.

"*An Experiment.*—I made two sinks in one piece of brass: one of them simply by a countersink tool, the other I finished as above described. I filled both with the same oil. In a fortnight's time the oil in the rough sink was like green paint; at the end of a year, that in the polished sink was so to say *unchanged*, except that it was a little paler.

"The general complaint of my brother watchmakers of these effects of oil, induced me to give publicity to this little discovery." *Revue Chronométrique.* No. 100.

[In watches, the interposition of *gilding* doubtless very much neutralizes the effects on oil referred to above; but in marine chronometers, clocks, &c., where the oil in the sink is in immediate contact with the brass, the preservation process above-named, and which is no doubt in good work generally followed, is, as well as for new holes in repairs, to be recommended.]

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MEAN DAILY RATE OF MARINE CHRONOMETER No. 49,

BY

LOUIS URBAN-JÜRGENSEN,

OVER A PERIOD OF MORE THAN TWO CONSECUTIVE YEARS, VIZ.:

FROM SEPTEMBER 8, 1852, TO MARCH 21, 1855,

Compared with an Astronomical Regulator, corrected by transit observations at the Royal Observatory of Copenhagen.

Date.	Comparison with Mean Time.	Daily Rate.
1852.	m. s.	s.
8 Sept.	+ 5 1·5	
6 October	+ 5 16·0	+ 0·5
10 Nov.	+ 5 36·0	+ 0·5
1 Dec.	+ 5 48·5	+ 0·5
22 „	+ 5 55·0	+ 0·3
1853.		
22 January	+ 5 56·5	+ 0·1
9 February	+ 6 4·0	+ 0·4
2 March	+ 6 11·5	+ 0·4
14 April	+ 6 29·0	+ 0·4
11 May	+ 6 31·0	+ 0·1
29 June	+ 6 45·5	+ 0·2
20 July	+ 6 53·0	+ 0·3
31 August	+ 6 56·0	+ 0·1
28 Sept.	+ 6 49·0	− 0·2
19 October	+ 6 47·0	− 0·0
28 Dec.	+ 6 38·5	− 0·1
1854.		
4 January	+ 6 48·0	?
15 February	+ 6 47·0	+ 0·2
29 March	+ 6 39·0	− 0·2
26 April	+ 6 33·0	− 0·2
28 June	+ 6 16·0	− 0·2
19 July	+ 6 17·0	0·0
16 August	+ 6 39·0	+ 0·8
30 „	+ 6 45·0	+ 0·4
27 Sept.	+ 6 35·0	− 0·3
25 October	+ 6 27·5	− 0·2
22 Nov.	+ 6 25·5	− 0·1
27 Dec.	+ 6 8·0	− 0·5
1855.		
24 January	+ 5 50·0	− 0·6
28 February	+ 5 33·0	− 0·5
21 March	+ 5 12·5	− 0·9

REMARK.

Towards the end of March, 1855, the Chronometer was taken down and cleaned.

THE REGULATING BALANCE-SPRING,

IN MARINE BOX CHRONOMETERS, OUGHT TO BE MADE OF A CERTAIN ALLOY OF GOLD, IN PREFERENCE TO STEEL.

Such balance-springs have the invaluable advantage, in preference to springs of steel, that they are neither exposed to *rust*, nor being influenced by magnetism.

The experience of a great many years, acquired in my position as coadjutor to my father, until his demise in 1830, and since that time as manager of the establishment for the manufacture of chronometers and watches founded by him, has sufficiently convinced me of—especially by the great number of English chronometers having for a long series of years been forwarded to the establishment for repair—how frequently steel balance-springs are injured by rust. The very smallest spot of rust on the balance-spring is sufficient to derange the regularity of the rate of the chronometer entirely, and the steel balance-spring is at the same time much exposed to be attacked by rust, partly by the unavoidable dampness on board, and partly by touching it accidentally with a clammy or damp hand.

A chronometer with a steel balance-spring may thus go very well for several years, but suddenly it ceases to be exact, and this derangement arises frequently and entirely from a small spot of rust, almost imperceptible, by which the steel balance-spring has been attacked.

Magnetism may likely also exercise

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a detrimental influence upon the steel balance-spring, especially on board steamers built of iron:—for example, ships of war, clad with armour plates.

For the said reasons I prefer therefore the gold balance-springs of a certain alloy, and executed in a manner suitable to the purpose for the steel balance-springs generally applied. Thirty years' experience has proved that the golden balance-springs, as applied in our chronometers, have not only all the elasticity desired, but they contribute also to maintain the regularity of the rate for a long series of years.

I must however remark, that the golden balance-springs require, on account that they are exposed to expand in a greater measure by the influence of the temperature, more compensation than the steel balance-springs; but I do not see any detriment in this respect, as compensation weights cannot be dispensed with; and it, besides, is easy to modify the compensation, without thereby losing anything with respect to accuracy. The golden balance-springs are also specifically heavier than the steel balance-springs, and therefore not so well appropriated for pocket chronometers, which constantly are exposed to exterior shakings.

According to the experience gained, I recommend, therefore, every constructor or manufacturer of chronometers to apply golden balance-springs for box chronometers, and abandon steel balance-springs, for I am fully convinced that gold of a certain alloy, sufficiently pliable and compact, as also when drawn to a proper hardness, is the only metal that, on account of its properties, is appropriate for the making of these balance-springs, when the injurious influence, principally exercised by rust, and perhaps also magnetism, are to be avoided in a *radical* manner.

LOUIS URBAN-JÜRGENSEN.

Copenhagen, November, 1863.

THE METRICAL AND DECIMAL SYSTEM.

Concluded from No. 63.

The great argument in favour of the introduction of the metric system here has been its extreme mathematical accuracy, and the presumed ease with which the standard could be recovered and verified in case of the original being destroyed. Instead of such being the case, the unit is founded in error, which, according to the arguments of Sir William Armstrong, is sufficient reason for its abandonment. For we have been told that instead of the quadrant of the arc of the meridian being, as the metric system supposes it to be, 10,000,000 metres, it is 856 metres more. This fundamental error necessarily vitiates the whole series of weights and measures, and the kilogramme should be augmented by 257 milligrammes. Whether it is of importance or not, it certainly destroys all pretensions of the metric system to strict mathematical accuracy. The great pretended merit of the metric system is that the base—the metre—is intimately connected with the earth, and can always be recovered in every part of the globe in case of the original in Paris being destroyed. But before the French Commission terminated their labours, they became aware that all their proceedings were based on error, and that no future measure of the quadrant of a meridian would give their length of the metre as its ten millionth part, and consequently, should the standard be destroyed, the most deplorable confusion would ensue. Accordingly Borda was employed to compare the length of the metre with the length of the pendulum, vibrating seconds in 45 degrees latitude, in order to enable it to be recovered without measuring an arc; so that, notwithstanding all the outcry and all the pretensions set up to strict mathematical accuracy, and the highest scientific character, as compared with our imperfect system, which Mr. Cobden termed "illogical, utterly inconsistent, dislocated, and inconsistent," the French metrical system draws its base—the metre—from the same source that we obtain the length of our yard, which is the base of our lengths and measures. The reader will doubtless be led to inquire why the French refused to have recourse at first to the pendulum, which would have given to both countries the same unit of linear measure—preparatory, in all probability, to the establishment of international uniformity—and why they preferred to run the risk of creating a system based on

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error, that must sooner or later lead to confusion. The "reason why" will be found curious, but quite French. On the 4th Messidore, year 7, M. Delambre appears at the bar before the two councils of the legislative body—the Cinq Cents and the Anciens—to present in the name of the Institute the standards of the metre and kilogramme, and he then stated that the object of the metric system was to entitle a Frenchman to say—"*Le champ qui fait subsister mes enfans est une telle proportion du globe. Je suis dans cette proportion co-propriétaire du monde.*" Elsewhere we read, "The earth is the Lord's."

There is no lack of evidence of the inconvenience of the metric system, furnished by practical experience during many years past, which fully justifies the apprehension entertained when it was first started. Even Laplace, the last few years before his death, was seriously disquieted by the anticipated discordance between the kilogramme and the metre, and, in defence of the system elaborated under his presidency, he urged the facility it affords for arithmetical calculation, as compared with the vulgar system, but he admitted that "our arithmetical scale (the decimal one) is not divisible by three and by four—two divisors whose simplicity renders them very usual," and he declared that the addition of two ciphers or new figures would have sufficed to procure that advantage. But he feared the duodecimal system would neutralize the advantage of having ten digits to count upon. To Laplace we may oppose Professor Playfair, who reviewed in the first number of the *Edinburgh* for 1807 the first volume of Delambre's work on the Base du Système Metrique, and whom Mr. James Yates, Secretary of the International Association, with a recklessness rarely surpassed, quotes as being the author of a "most beautifully written article," in which he expressed "a decided wish that the system should be adopted in this country." Professor Playfair was an admirer of the labours of the French Commission, but he was anything but a thorough partisan of the metric system. He objected to several of its features, to which objections Delambre replied in the third volume of his work, that appeared in 1810. This is what the Edinburgh Reviewer did say more than half a century ago, and his opinions deserve the most careful attention now:—

"Ten has indeed no advantage as the radix of numerical computation, and has been raised to the dignity it now holds merely by the circumstance of its expressing the number of a man's fingers. Those who regard science as the creature of pure reason, must feel somewhat indignant that a consideration so foreign and mechanical should have determined the form and order of one of the most intellectual of all sciences. The duodecimal scale would nowhere have been found of greater use than when applied to the circle in which the decimal system is liable to the strongest objections. The number by which the circumference of the circle is expressed ought not only to be divisible into four integer parts—as in the French system (which divided the circle into 400 grades, subdivided into 100 minutes, and these into 100 seconds), but also into six; for the sixth part of the circumference, having its chord equal to the radius, naturally falls in the construction of instruments and in the computations of trigonometry to be expressed by an integer number. According to the decimal division of the quadrant, the sixth part of the circumference not only is without an integer expression, but the decimal fraction by which it is measured is one that runs on continually with any termination. This is at least a deformity that arises from the rigid adherence to the decimal division: and it is probably the main cause why that division has been found so difficult to introduce into trigonometrical and astronomical calculation. In astronomical tables we believe it has never been adopted."

Following the same side, Mr. John Quincy Adams, who was the commissioner appointed by the United States' Government to inquire into the desirability of adopting a decimal system, reported,—

"The decimal system can be applied only, with many qualifications, to any general system of metrology; its natural application is only to numbers; and time, space gravity, and extension inflexibly reject its sway. It is a contrivance of man for computing numbers, and not a property of time, space, or matter. Nature has no partialities for number ten, and the attempt to shackle her freedon with it will for ever prove abortive."

Professor de Morgan insisted on the necessity of keeping distinct decimalization and metricalization, two things often confounded. He was as much for decimal division as any person could be, which he believed might be easily introduced, and would co-exist perfectly well with the binary division, which he was satisfied must always be used by the common people. He objected to the introduction

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of French units into this country upon the balance of convenience and inconvenience. It would create such an immense amount of confusion throughout the country that the inconvenience would far more than counterbalance the advantage we should derive in our foreign commercial relations. The metre was objectionable. It arose from a mere fanciful connexion with the quadrant of the meridian, and is of no practical importance to any man alive. "You might just as well," said the Professor with polished sarcasm, "try to subdivide the distance from the earth to the moon." The metre is too long to be the common measure, and the next decimal division—the decimetre—would be too short to take the place of our foot. The litre—about a pint and three-quarters—is either too large or too small. Half a litre would not do, because that would destroy the decimal character.

Mr. William Fairbairn was not prepared to say what would be the best standard or the unit, but he believed the foot or the inch would be the best.

Mr. C. H. Gregory, C.E., freely admitted that there may be difficulties in the way of the adoption in England of the French standards for money, weights, and measures, which, when considered by those who devote themselves deeply to the subject, may be judged to outweigh the advantages of an identity of our weights, and measures, and money with the French system. All he desired was the decimal division of our scales.

Mr. J. A. Franklin, a professional auditor, did not believe it would be just as easy to induce Englishmen to measure length and capacity by the metre as it would be by the decimal multiples of the foot. A change is not universally or generally desired. The differences which exist between the scales of various localities are rather modes of expressing weight and measures than a difference in the weights and measures themselves. The pound avoirdupois is recognised universally, and the witness objected to anything else but 7,000 grains being called a pound in Great Britain.

To present a Bill to Parliament, and assert that it is based upon such evidence in favour of the introduction of the metric system here, is to be almost sublime in audacity. It looks much like a breach of good faith and like an attempt to palm off an imposture on the public, for the metrical system is not what it is said to be. It is not accurate; it is not symmetrical; it is not logical; it is not consistent; and it is not logically sequential, as Mr. Cobden declared it to be, and yet we are asked to adopt it instead of the English system, which, as Mr. Taylor truly says, "has for its foundation all the scientific accuracy attributed to the French, with the further recommendation that it has stood the test of actual experiment for above 4,000 years."

[The writer of this article in collecting some valuable information, seems inspired by much too partizan a spirit for scientific purpose. As regards an accurate standard, he seems to prove too much, for the large error in the French metre which is dwelt upon, but which he admits is of questionable importance, is an error less than a ten-thousandth. The probability of a much greater error in the exact measurement of a seconds' pendulum, under fixed conditions, seems a far greater likelihood. Evidently a considerable error in the measurement of ten million yards may be imperceptible when reduced to the unit, while in measuring a standard, an extent but a few inches more than that unit, the minutest error becomes pernicious. We cannot but think the logic to be on the side of measuring a large surface, and reducing it for a standard; the allusion to the English standard having an antquity of four thousand years, if it depends upon the vibration of a pendulum is also more than obscure.

British Horological Institute.

PRIZE FUND.

DETACHED LEVER ESCAPEMENT.

PRELIMINARY NOTICE.

Agreeably to the plan sketched out in the last year's report, the Council are enabled to announce that the following programme is submitted to the members of the trade.

A substantial prize, the amount of which will be governed by the subscriptions received, will be given for the best "Treatise on the Detached Lever Escapement and its varieties." To fulfil the object of the prize-donors, it is desirable that the

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treatise should embrace the history of the various improvements in the Lever Escapement to the present time, pointing out the advantages said to be obtained by each, together with practical directions for securing the action sought by the inventor. It should also treat of the subject generally, giving tables of proportions of the various parts for the ordinary constructions, and explaining the effects of variations in these proportions. It is also extremely desirable that the procedure followed by an expert escapement maker, in making a first-class escapement, should be clearly described. To make the essay still more practically useful, it should notify to the examiner the points to be especially tested and the best means of rectifying any discovered error.

Various tools for effecting the several measurements and for facilitating the completion of the escapement should also be described. The text would be more readily understood if illustrated by simple diagrams.

The treatises should be forwarded on or before a date, to be subsequently fixed, under cover to the undersigned at the Institute. Each treatise must be marked with some device or motto and should be accompanied by two envelopes: one superscribed by some motto, and containing the name and address of the writer, only to be opened if the essay is successful; the other envelope to be addressed to Mr. Klaftenberger, at the Institute, to contain the names of two gentlemen proposed as the judges.

There will be three judges: one of whom will be nominated by a majority of the subscribers at a meeting of that body; and the other two to be nominated by the authors of the essays, as above. Should two names not be nominated by the authors, or should there be an equality of votes, or should any refuse to act, the question will be determined by a majority of the subscribers.

The judges will have the power of withholding the proposed prize, should the essay, or essays, not come up to the required standard.

The judges will be requested to give their decision in not more than one month from the receiving the essays for award.

The essay to which the prize may be awarded will become the property of the subscribers for publication, in any way that they may deem most advisable; but if not published within a period of six months, the property therein shall revert to the author.

Any profit which may arise from the publication shall be devoted to the increase of the prize fund.

As the present announcement is but the opening of a plan for encouraging the publication of knowledge connected with art, and for promoting improvement in the manufacture, the assistance of members of the trade, by subscriptions, is requested. Donations may be forwarded to the Honorary Secretary of the Prize Fund, at the Institute, or through any subscriber to the fund.

Subscriptions will be acknowledged periodically in the *Horological Journal*, the pages of which are open to communications on the subject.

Intending subscribers are requested to forward their names or subscriptions before the 1st February, to enable the Committee to commence their work.

A general meeting of subscribers will be held at the Institute at eight p.m., on Wednesday, the 3rd February, to fix the amount of award, and finally to decide on the terms of competition; which meeting, all are requested to attend.

JNO. JONES,
Chairman of Committee of Prize Fund.

RD. STRACHAN,
Honorary Secretary to the Committee.

DEATH OF MR. ROBERT MILLER.—Our obituary to-day records the death of Mr. Robert Miller, clockmaker, Royal Exchange. Mr. Miller was in his forty-second year. His death was accelerated, if it was not altogether caused, by internal injuries received on the evening of the 1st January, 1861. On that evening Mr. Miller was proceeding to the railway station along with a friend, when he was savagely attacked by a band who at that season of the year have been in the habit of assaulting peaceable citizens. The last public work performed by Mr. Miller was the execution of the fine new clock in the spire of St. Mary's, Broughton, and many of the principal clocks in Scotland were constructed by him.—*Scotsman.*

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THE WATCH TRADE OF GENEVA.*

IT is a matter of some interest to inquire whether the manufacture of watches in Geneva is likely to remain in its present state of depression, or whether, from certain causes to which it has been subject for a time, this depression will disappear with the unfavourable circumstances which caused it.

It would be almost impossible for any person, unconnected with watchmaking, to arrive at a correct view of the case, viz.: of the great amount of industry, and of the vast quantity of watches which are annually manufactured in Geneva. The difficulty arises from various causes, but chiefly from this, that it is not imperative to have the Government stamp engraved on each watch. This mode of testing the exact number of watches made in the city would, therefore, prove erroneous, and, even if obtained, would not be satisfactory, as a good many case-makers and engravers work for Neuchâtel, where they send their unfinished watches, which claim afterwards no other origin but that of Geneva, though they may have no right to it.

The result of any inquiries made at the office of the public taxes would be equally fallacious, as it is not likely that the real number of watches made is ever stated by the makers.

The only way of getting as near the truth as possible is, by basing your calculations upon certain data current among the manufacturers themselves, and knowing the number of watches which some of them produce annually, and the number of workmen employed by others. You may thus arrive at the total number of watches manufactured, which, though not an easy task, may still be achieved by anyone thoroughly versed in the matter, and not afraid of tedious researches.

It should be observed that in such an inquiry great care must be taken not to mistake for Geneva manufacture the goods sold by those manufacturers who get all their watches from Neuchâtel, a practice by no means uncommon. The city of Geneva does not manufacture one-fifth part of the watches which are manufactured in the Canton of Neuchâtel; the small city of Chaux-de-Fonds alone (whose inhabitants are all watchmakers), yearly make twice as many watches as Geneva does.

After the political events which disturbed all Europe in 1848, the trade of watchmaking was thoroughly paralysed in Geneva, and seemed for some time, past revival. Money and credit were equally wanting, and the workmen employed before that time in the great manufactories became so utterly destitute, that they were nearly driven to desperation.

The Government took every measure in their power to ameliorate this alarming state of things, and, seeing the utter hopelessness of trying to revive this particular branch of industry, for which there was at the time no market, they created the national "chantiers," where every citizen could find a retreat against starvation, by becoming carpenters, road-makers, hedgers or ditchers, &c. These national "chantiers" gave work to an immense number of hands during two years. In 1850 they were reduced in number, from the fact that the trade of watchmaking appeared to revive in some degree. The greater part of the manufacturers re-opened their workshops, but they set to work with extreme circumspection, the political horizon being still very far from encouraging. It was then that the evil results of what had been for the time a means of salvation became evident. Those men who had left their quiet and comparatively easy work, to take to the trowel and spade for a certain length of time, and who during that time had, for the greater part, adopted the loose habits of common labourers, had become totally unfit for their former trade; some had lost the taste, some the neatness of hand required for such work, and all were dissatisfied. It is supposed that the city of Geneva did not issue more than 30,000 watches in the year 1850.

In 1851 the London Exhibition gave new vigour to this industry. The workmen took heart, and an immense number of watches were made; fresh markets were opened; North and South America offered a vast field to traders; watches

* This information has been furnished by one of the Geneva watchmakers, and is a principal portion of Mr. Burnley's (H.M. Secretary of Legation at Berne) report to the Foreign office for 1862.

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were sent from Geneva to all parts of Europe and elsewhere: Russia, Turkey, Egypt, were inundated by them, as well as India. Not less than 60,000 watches were manufactured in Geneva in the year 1851.

The years 1852 and 1853 were similar to 1851, with this difference, that the markets of North America having become more and more extensive, and their demands for watches more and more important, the Genevese manufacturers threw themselves wildly upon these new hopes, increasing the extent of their trade to irrational limits, and sending their goods to America in enormous quantities. And it is to be observed that the goods thus sent were not only those that American merchants bought or ordered, but were goods sent conditionally to commissioners of whose respectability or solvency nothing whatever was known to the manufacturers, who risked sometimes their whole fortune on such frail probabilities of payment. Numberless agents started up in the principal cities of North America—New York, Boston, Philadelphia, New Orleans, and even San Francisco had their agents, whose demands for watches were unlimited and extravagant.

As happens in everything of the same kind, these first years of success brightened the hopes of all manufacturers, and every one seemed to believe that a new era was beginning for the prosperity, not only of Geneva, but of all those cities of Switzerland whose chief trade lies in watchmaking. In 1855 an enormous number of watches were made, and new agents set up in Paris and elsewhere, as they had done in America.

We may here state that during the disastrous years 1848-51, public banks had been created, with a view of affording accommodation on easier terms to those manufacturers who wanted funds. Among these establishments were, the Bank of Geneva, the Caisse d'Escompte, the Swiss Bank, &c., which principally supported watchmakers; but, unfortunately, the Caisse d'Escompte, on which the manufacturers had built their greatest hopes of renewed prosperity, soon became their ruin. The mode of payment between manufacturers and workmen underwent a gradual change; payments were no longer made in cash; bills and drafts were circulated to an enormous amount, and the meanest workman had an account opened in the Swiss Bank, or the Caisse d'Escompte, where he could negotiate his bills.

The Crimean war was beginning to tell in the shape of scarcity of money and scarcity of demands for watches from the East. Goods were sent off to the American agents more rashly than ever; and some manufacturers even had recourse to the mode of having their conditional accounts with these agents negotiated in public banks, at whatever loss to themselves, as long as they could find ready money to get out of their entangled affairs.

The years 1856-57 passed in much the same manner; but the "Caisse d'Escompte," which had seemed to rise above the other banks, suddenly stopped its payments: a great number of manufacturers became, consequently, embarrassed, others insolvent, and all their hopes turned again, though in a less degree, towards America and Italy. Geneva and Neuchâtel were struggling against each other for the sale of their watches. Neuchâtel lowered its price, and shortly afterwards they sank so low that Neuchâtel watches were to be bought in New York for only 5 francs more than they had cost to the maker.

The "Comptoir d'Escompte" seemed for a time to replace advantageously the "Caisse d'Escompte," but again this assistance was of short duration; a great number of manufacturers were beginning to slacken their way of working—some, out of straitened circumstances; others, out of tardy prudence. America paid badly, and yet goods were still rashly sent to all its markets.

In 1858-59, the Italian war did much injury to Geneva. American payments became still less certain. Among the manufacturers very few were able to obtain money on their bills from public banks. A great many tried to sell off their stock, but that had become impossible.

At Neuchâtel other means of rescue were tried. The "Union Horologère" was created, and a Society for the Exportation of Watches, both of which had agents in every city of Europe, in China, in India,

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in America, and, in fact, all over the world. These associations sold watches at such reduced prices that it was impossible to compete with them, inasmuch as the laws of Geneva forbid the sale of any watches whose gold is not in proportion of $\frac{750}{1000}$, or 18 carats; whereas in other cities of Switzerland gold may be worked in an unlimited proportion to other metals, as no legal control is placed over it, and consequently at much less cost, though, of course, with a proportionate inferiority.

In 1859, work was slackened to nearly the half of the preceding years. In 1860, it did not come up to the third of the same amount; and in that same year, 1860, the creation of the "warrants" * struck a deadly blow at a great portion of the Geneva Manufacturers. In 1861 this state of things continued. A great number of shops—engravers', case-makers', &c.,—were compelled to close their doors and pay off their workmen. This was principally the case with those firms who worked for Neuchâtel.

* * * * * *

To sum up it may be stated that the great facility offered for procuring money has been the ruin of many Genevese watchmakers. The illusory help they found in these deceitful transactions affected others equally; the encumbrances were only displaced, but not removed; and this fallacious security tempted them out of the limits of all prudence to launch them into the most hazardous speculations. All the great markets are overflowing with Geneva watches. In London, New York, Paris, Constantinople, Odessa, St. Petersburgh, Swiss watches may be bought for less than their original cost to the maker; and during a certain period good watches have been sold in New York at half-price, and even for their weight of gold.

After having thus stated the lamentable decrease in its prosperity under which Geneva has been and is still labouring, let us proclaim our firm belief in the complete and inevitable revival of that prosperity, a belief founded on our own experience of the subject, and on the following reasons :—

1. As before stated, no Geneva watches are allowed to be sold except at a high standard of gold, which is a guarantee for their excellence and solidity; and though an inferior price may, for the time being, allure inexperienced buyers, still the inferiority in the goods always shows itself, and enhances the value of the superior watches; and this, in the end, brings the buyers to the best makers.

2. In what is called "bad years," Geneva will, proportionately, make more watches than Neuchâtel; for although its prices are twice as high, the superiority of them is always known; and it would be easy to prove by figures that Geneva finds market for its watches more easily than does Neuchâtel for its inferior goods. The consequence of this is that, at the greatest depression of the trade, Geneva suffers still less than Neuchâtel, and, consequently, preserves more strength and means to carry on the struggle against adverse circumstances.

The following is the number of watches turned out by Geneva in the last eleven years :—

In the year	1850	.....	30,000	watches
„	1851	.....	70,000	„
„	1852	.....	70,000	„
„	1853	.....	80,000	„
„	1854	.....	80,000	„
„	1855	.....	70,000	„
„	1856	.....	70,000	„
„	1857	.....	60,000	„
„	1858	.....	60,000	„
„	1859	.....	60,000	„
„	1860	.....	40,000	„
„	1861	.....	30,000	„
		Total	720,000	„

After all, a manufacturing city which has issued so many watches in a space of eleven years, is not quite paralyzed, and 720,000 are large figures. There seems every reason to hope that Geneva will rise again; for never, in its brightest days, has it issued more than 60,000 watches annually on an average. It will rise again, and more easily than may be expected by inexperienced judges, who are not aware of all the resources, perseverance, and elasticity of the working classes, with which a long experience has made the writer of this acquainted, and in which he is fully confident for the revival of this national industry as soon as external circumstances (which seem already

(To be continued.)

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., NOVEMBER, 1863.

11, *Offord Road, N.*

Day of the Month.	Barometer, at 32° F, and mean sea level	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9A.M.	During the next 24 hours
	inches.	o	o	o	o				
1	29·615	42	39	53	39	SW	5	cb	o, rrq
2	28·931	44	42	49	40	W	3	o	rqqo
3	29·881	43	39	51	36	W	4	o	r, oq
4	·947	57	54·5	57	37	W	6	o	o, rqq
5	30·204	54	52	59	53	W	3	o	r, o
6	·505	39	34	57	38	N	2	b	cb
7	·270	45	44	48	38	W	2	m	r, o
8	29·950	49	48	53	49	SSW	2	r	rq
9	30·203	43	40	51	40	NE	4	o	bc
10	29·906	38	36	53	30	SW	2	r	r, om
11	·388	36	34·5	45	33	SE	2	m	bcm
12	·812	38	36	43	32	NNW	3	b	b
13	30·300	37	35	45	32	W	1	f	m, b
14	·302	49	47	49	34	W	2	m	o
15	·270	50	47	51	47	W	2	o	o
16	·196	51	49	53	47	WSW	1	o	o
17	·164	52	49	54	49	WSW	4	o	o
18	·284	50	46	53	48	SW	2	o	o
19	·244	48·5	45	51·5	46	SSW	2	o	o, bc
20	·200	47	44	50	41·5	SSW	3	o	o, bc
21	29·874	50	48	50	41	S	3	c	bc, rr, b
22	·830	45	42	55	41	SW	4	bc	bc, r
23	·887	45	42·5	50	43	WSW	3	c	c, m, r,
24	·893	52	51	52	44	S	3	r	r, o, bc
25	30·053	55	54	55	50	SW	2	o	bc
26	·376	41·5	49·5	56	45·5	S	1	om	o
27	·401	52	50	52	47	S	1	om	cb
28	·332	44	41	50	41·5	S	1	o	bc
29	·341	34	32	45	31	SE	4	bc	bc
30	·188	35	33	42	30	E	2	m	o, c, m
	30·058	45·9	43·5	51·1	40·8		2·6	Mean	

REMARKS.

At 7 am., 2nd, the atmospheric pressure was as low as 28·90, and about noon, 6th, as high as 30·54; hence the extreme range was 1·64 inches.

On the 2nd, a violent gale blew from S.W., veering to N.W. On the 4th, there was a gale from S.W. to W.; and between 4 and 7 p.m., 21st, a gale blew from S.W.

Between the 9th and 13th, the wind veered from E. to N., W. S., and E. to N., W. and S. again.

Rain fell on 12 days, during about 90 hours, to the amount of 1·85 inches.

According to the table, the winds blew in proportion of 2 from N., 3 from E., 11 from S., and 14 from W.

INDICATIONS FOR JANUARY.—The sun in the middle of this month continues about 8¼ hours above the horizon in England. At London, the *day* temperature, on an average of twenty years, is 43°, that of the night, 34°; the mean height of the barometer is 29·95 inches, with a range of 1·4 inches, the prevailing winds are from W. to N.; the mean amount of rain is 1·9 inches on 12 days, snow included; most of the nights are frosty. These indications will be found tolerably accurate and serviceable, for the greater part of England; and serve as standards for comparison of observed results.

EQUATION OF TIME TABLE.

For January, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *added* to Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Fri . .	1	3 37.87	1.188	3 37.80
Sat . .	2	4 6.23	1.175	4 6.15
Sun . .	3	4 34.26	1.161	4 34.17
Mon . .	4	5 1.94	1.146	5 1.84
Tues . .	5	5 29.25	1.129	5 29.15
Wed . .	6	5 56.14	1.111	5 56.03
Thur . .	7	6 22.58	1.092	6 22.46
Fri . . .	8	6 48.55	1.071	6 48.43
Sat . . .	9	7 14.01	1.049	7 13.88
Sun. . .	10	7 38.91	1.026	7 38.78
Mon . .	11	8 3.24	1.002	8 3.11
Tues . .	12	8 26.98	0.976	8 26.84
Wed . .	13	8 50.08	0.949	8 49.94
Thurs .	14	9 12.52	0.921	9 12.38
Fri . . .	15	9 34.30	0.893	9 34.16
Sat . . .	16	9 55.38	0.864	9 55.24
Sun . .	17	10 15.75	0.834	10 15.61
Mon . .	18	10 35.41	0.804	10 35.27
Tues . .	19	10 54.33	0.773	10 54.19
Wed . .	20	11 12.50	0.741	11 12.36
Thurs .	21	11 29.91	0.709	11 29.77
Fri . . .	22	11 46.54	0.677	11 46.41
Sat . . .	23	12 2.40	0.645	12 2.27
Sun . .	24	12 17.47	0.612	12 17.34
Mon . .	25	12 31.75	0.578	12 31.63
Tues . .	26	12 45.24	0.545	12 45.12
Wed . .	27	12 57.92	0.512	12 57.81
Thurs .	28	13 9.79	0.478	13 9.69
Fri . . .	29	13 20.87	0.445	13 20.77
Sat . . .	30	13 31.14	0.412	13 31.05
Sun . .	31	13 40.62	0.378	13 40.53

All Communications for this Journal should be addressed to the EDITOR, *at the Office*, 35, Northampton Square, Clerkenwell.

Our pages are at all times open to correspondence and contributions, either original or compiled from good authorities; but the contributors are alone responsible for their own opinions.

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BRITISH HOROLOGICAL INSTITUTE.

ELEVENTH HALF-YEARLY MEETING.

The half-yearly meeting was held at the Institute, 35, Northampton Square, on the 29th December. The chair was occupied by Vice-President, John Jones, Esq., F.R.G.S., and amongst the members present were Mr. Vice-President Klaftenberger, W. Hislop, F.R.A.S., Honorary Secretary, Mr. Blackie, Treasurer, Messrs. Strachan, Glasgow, H. G. Webb, Pricket, Hewitt, Brooks, Browning, Mylne, Palmer, Storer, Mercer, &c.

The honorary Secretary read the notice convening the meeting.

The minutes of the last annual meeting were read and confirmed.

The Honorary Secretary then read the following report and audited balance sheet.

"Your Council regret that the eleventh half-yearly report is not so favourable in point of finance as the last. The amount and number of subscriptions on the books remain with little variation; but the receipts towards the end of the year have become gradually less, leaving a considerable amount in arrear.

The Council beg to express a hope that the members will see that it is impossible for their officers to keep the engagements made in their behalf, or conduct the business of the Institute, unless their subscriptions are regularly paid.

The measures which were stated in the last report to be in progress for the improvement of the Journal, have been successfully carried out, at a reduced cost to the Institute, and the Journal now presents an appearance worthy of a scientific society, and it is on the whole increasing in circulation.

The weekly Conversational Meetings have been continued, but are not so well attended as might be desired.

The question of gauges for horological use has reached a point at which the Council think that something might be done in the way of constructing a standard for reference. This should, in the first instance, be a carefully divided scale, with means of readily verifying other scales. Funds are necessary for carrying this object out.

The Prize Fund has slowly increased, but a final determination as to the amount to be offered, and other details, have been deferred to a future date by a majority of the subscribers. The Council have further to say that they have had under consideration the action of the Goldsmiths' Company in the interests of the trade, both in regard to the charges for stamping, and the injury done to the work by the mode of stamping. On this subject they will be happy to receive information from the members of the trade, and hope shortly to submit a tangible proposition on the subject.

With respect to the future, the Council hope that an interest will be awakened in the meetings for discussion of subjects connected with the trade, held at the Institute; and they purpose, if possible, to obtain some lectures on matters relating to the manufacture of Watches, Clocks and Chronometers, at an early date.

The trade has passed through a long period of depression, which has necessarily restricted the progress of the Institute; but the Council are happy to know that signs of improvement are appearing, and think that the Institute will share in the coming prosperity."

ACCOUNT OF RECEIPTS AND DISBURSEMENTS FROM JUNE TO DECEMBER.

Dr.	£	s.	d.
To Balance in hand at last audit ...	13	11	3½
„ Donations and Subscriptions.....	81	12	0
„ Cash received for Journals	12	17	9
„ Do. do. for Advertisements	23	16	4
„ Rent from Mr. Palmer, to Michaelmas	10	0	0
„ Sundries	0	9	3
	£142	6	7½

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Cr.	£	s.	d.
By Rent, Taxes and House Expenses	36	4	3
„ Salaries, Wages and Commission	38	1	3
„ Printing, Engraving, &c., for Journal	42	13	6
„ Stationery, Stamps, &c.	7	4	5
„ Printing and Advertising	1	15	4
„ Newspapers, Periodicals, &c.	3	9	7
„ Mr. Palmer, care of premises, Michaelmas, 1863	10	9	0
„ Sundries	1	2	0½
„ Cash in hands of Treasurer	1	6	7½
„ Do. do. Hon. Secretary	0	0	6½
	£142	6	7½

The Chairman then rose and said—"Gentlemen: It is usual for the Chairman upon these occasions to say a word or two in recommending the adoption of the report of the Council. I wish that there had been a larger attendance of the members of the Institute present, as it would have indicated, on their part, a greater disposition to co-operate with the Council in the cause which, as managers of this Institute, it has undertaken to promote. The desire of the Council is the general improvement of the horological art by the cultivation of the mental powers of its members. And really it is a necessary duty to be undertaken at this time; for, even within the limits of the knowledge which I possess of the members of the trade, I have heard during the last year of many men having left it and gone into other occupations, because watchmaking was no longer sufficiently remunerative to induce them to remain at it. Surely these are matters which concern the whole trade. There are, perhaps, out of doors, members who are indifferent to these matters, who say, practically at least, 'Let others work; I will enjoy the honey that others have so industriously gathered, but I will not trouble myself to contribute my share to the common stock.' That is an unworthy position for any one to stand in towards his brother workmen. Why, gentlemen, we really do not belong to a trade which has gone out of fashion. If that were the case, we then, perhaps, might be justified in saying that it was time for us all to be looking about us to find a resting place in some other profession or engagement; but the fact is that the articles we manufacture are as much in vogue now as ever they were. Why then is it that we hear of such facts as that men have left the watchmaking business and gone, for example, to Woolwich Arsenal to manufacture guns or fusees to warlike projectiles? It is because we, as manufacturers, are exposed to great competition from abroad. If this Institute did nothing else in the way of benefiting the trade, it would be doing a great good by bringing out that fact prominently before its members. Peace has its battles as much as war, and the contest which we have to wage is a commercial one, between the men of Clerkenwell, Coventry and Liverpool, as against the several centres of manufacture upon the continent. Now, if we can bring this fact prominently before the minds of the members of the trade, it will lead them to see that they are not in the enjoyment of a monopoly, but that they are exposed to the world's competition; and that the only preferable claim which a workman can possess must be that his work is superior in quality to that of other men. The knowledge of that fact would at once give an energy to our workmen which, without the knowledge of that fact, I doubt whether they would ever possess. If this Institute, I repeat, has done nothing else than tell the members of the watchmaking trade here, that there are manufacturers on the other side of the Channel besieging our customers—the public, and endeavouring to convey them away from us into their tent or camp, we shall have done much for the trade. By so doing we shall get rid of a great deal of indifference which now prevails, and induce a readiness, on the part of the workman, to apply himself to his own improvement, to listen with attention to every suggestion made to him, and manifest a desire to carry it out, let it come from where it will, provided it tends to the improvement of the manufacture. We shall thus give a constant impetus to every man's mind to endeavour to produce tools by which he can improve the quality of his work, or bring in the application of new principles of nature or new agencies for the improvement of the whole of the horological art. If we do nothing else in the way of communicating knowledge, but merely tell men there is an enemy assailing you, and you must fight him by increasing your skill and the extent of your knowledge, we shall have done much to promote the benefit of the trade. One striking instance of the good the Institute has done in the way of warning the trade was, the translation in the last number of the *Horological Journal* of a very remarkable article which recently appeared in the *Constitutionel*, in which, with the most self-complacent spirit, and with affected dignity, the writer fairly challenges our pride. He speaks of the English watch trade as being in a state of decay, as having lost all that superiority which it once enjoyed, and as being actually indebted for the position we now hold in the world as manufacturers to the skill of Foreign artizans. Now that is a statement which it does not become us to smother. This is an allegation which we are not afraid of, because we know that it is an exaggerated falsehood; but still there is an useful lesson to be drawn from it, namely, that if we are supine and allow this statement to go forth without any contradiction or counter statement, it would give a certain amount of consistency and appearance of truth to the statement which it does not possess, which would render it difficult for us to keep a certain reputation in the public mind of the world, which is at present in our hands, and which is our great main stay. Gentlemen who have spoken at the meetings of the Institute, have complained of the backwardness of the members of the trade in supplying the Council with the means of maintaining the Institute in a proper state of efficiency; but I hold that there

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has been no particular deficiency of funds—as you have heard from the report, the Institute, instead of being insolvent, is more than solvent. But I think that the council will justify me in what I have said about the necessity of bringing a certain amount of pressure upon every member of the trade; for it appears to me that they all have a personal interest in its efforts, of whatever value they may be made by the managers of the Institute. As I have already said, it has done something, if only by the *Journal* bringing before us facts with reference to the estimation in which we, as watch makers, are held on the Continent. Then the Council has brought another matter under the notice of the trade which is well deserving of its attention. The mode of manufacture, or stamping of our watches, adds greatly to the cost of our work in comparison to that which the foreign manufacturer is subjected to. Our manufacturers well understand the disadvantages we labour under in regard to the commercial extension of our business, by reason of the solidity of work which we are used to adopt, and which certainly gives a superiority to our machines over those made on the continent. But, whilst we appreciate the extra utility of our work, we are sensible that it is highly desirable that we should be freed from all obstructions in our own manufacture which will impose upon us an extra cost in production. A long and prevalent complaint is, that a very considerable amount of the labour expended in the manufacture of the case is lost by the rough and injurious manner in which the Goldsmiths' Company stamp them. The persons employed to stamp watch cases handle them as though they were silver spoons, or other heavy material, to which a few blows more or less would have no particular detrimental effect; but our circular forms are necessary to be made truthful in character, and consequently they are very easily displaced or distorted by a slight blow, and much more by those ponderous strokes which the Goldsmiths' Company give to them. I have been informed, by those who are engaged in the manufacture, that this mode of dealing with the cases adds one-third to their cost of manufacture. The Goldsmiths' Company will not receive the case for stamping until it is so far formed that it can be well identified as being a case, and then they return it to the maker in such a disfigured form that it can hardly be known to be a true case at all. We have considered how far we can remonstrate with the Company and endeavour to improve its practice, and it has appeared to the Council a very proper duty for it to interfere to protect this part of the horological trade against an evil which interferes with the commercial excellence which it might otherwise attain unto. Again, the Council has had brought under its notice the amount of taxation which the trade is subjected to by the sum charged by the Goldsmiths' Company for the process of assaying, and which we are informed is not justified by the law of the land. The general indifference of the trade to matters affecting its own interests has led to this excessive demand being passed by unnoticed and unprotested against. The timidity with which case makers approached the Goldsmiths' Company, lest they should be subjected to a prejudicial bias on the part of the officials when they send their work, forbids them making victims or martyrs of themselves for the benefit of the rest of the trade. For this reason, case makers go on submitting to a large amount of taxation being annually levied upon them, which, if the subject were taken up by a general body like the Institute, and if it took measures to procure the abolition of that excess of taxation which is now imposed by the Goldsmiths' Company beyond what the law allows, it would exert a beneficial action on the trade and put itself above all sense of fear of possible injury. For my own part, I know of no reason why, if we cannot receive courteous treatment from the Goldsmiths' Company, we should not represent to the government and legislature that the British Horological Institute is as good an organisation for determining the standard value of the gold of which watch cases are made, as of providing guages by which the different parts of the watch should be manufactured. I feel persuaded that, if the trade would join with us in keeping this Institute as a living and active motive power in Clerkenwell, that we should have influence enough with the authorities of the land and with the legislature to get authority, if not to take the whole matter out of the hands of the Goldsmiths' Company, at least to procure the liberty of stamping our own work, leaving to them the right to deal with all other silver and gold goods. I have spoken of the excessive charge made by the Goldsmiths' Company for assaying, and one fact will prove my statement. If you step into Messrs. Watherston and Brogden's and ask for an assay only 1s. is charged for it. They will tell you whether the article is fourteen, sixteen, or eighteen carat gold for that sum; but if you step into the Goldsmiths' Hall and ask Mr. Watherston for the same assay, you are charged 1s. 9d.

Mr. H. G. WEBB.—Allow me to correct you; the charge is 1s. 6d. for a watch case.

The CHAIRMAN.—I am speaking of gold cases. I say that 1s. 6d. is charged for them without the pendant; but that 3d. more is charged if the pendant is attached to the case. I speak with much deference in the presence of gentlemen who ought to know so much better about the matter than I do.

Mr. H. G. WEBB.—I did not know you were speaking about the case with the pendant attached to it.

The CHAIRMAN.—One shilling and sixpence is charged for the case without the pendant; but in the conventional usage of the trade a case is not a complete case without the pendant. I repeat that if I take my watch case to Messrs. Watherston & Brogden's, with the bow attached to it, I should be able to have it assayed for 1s.; and for that sum they would tell me whether it was or was not made of eighteen carat gold, and

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for the same assay the Goldsmiths' Company will charge me 1s. 9d. Now the law under which the Goldsmiths' Company have a right to levy this tribute from our trade, also forbids them charging more than the cost price of the work done by them. It also requires that there should be a constantly diminishing cost to the trade, for the reason that the increased quantity of work would enable the Company, commercially, to do it at a lower price than it could at the smaller quantity, whereas the Goldsmiths' Company have invariably maintained one charge for the past century. They have made no alteration whatever. The amount charged by Messrs. Watherston and Brogden, or other persons in the business, is less than the amount of their charge. Now what is this owing to? Simply the supineness of the trade. I can hardly say that I particularly blame the Goldsmiths' Company in the matter, for they have not known the conditions under which we ought to stand, so indifferent to our interests have we been. I think that it would be a matter of surprise to the Honourable Court when they find this state of things. I think they also have made a mistake in reference to the charge made when a number of articles are sent in, especially in articles of jewellery. We can have an assay of one made at 1s. at Messrs. Watherston and Brogden's, but if I sent in a dozen articles of jewellery at the same time, I think that I could make a bargain with them for a wholesale price. That is, again, a material fact for the consideration of the Goldsmiths' Company, for watch-case makers are in the habit of sending their cases to them not singly, but in dozens. If a private firm can assay a single case for 1s., much more so ought the Goldsmiths' Company to do so, looking at the many thousand cases which it has from our trade to deal with—amounting to 30,000 gold and 70,000 silver in the year. What is the exact charge which they might fairly make I am not at this moment able to say; that is a matter of detail which the Council will direct its attention to when they have properly made themselves acquainted with the details of the matter. When the Council have matured their calculations in reference to it, they will submit the result to the trade. If the assaying can be done for 1s., the benefit might as well be in the hands of the trade at large. The Institute might make an arrangement with the case makers or the manufacturers, as the case might be, for the difference of cost in doing the work. The next point to which the Council has directed the attention of the Members in the Report is the Prize Fund, for which we want more money. There is an evident inclination on the part of watch makers to take up the competitive challenge which the Council has thrown down to them, but we want it taken up by those whose productions will be worthy of permanent record in the trade. Everybody engaged in the manufacture is concerned in this adventure. People who live in the country, the horologists at Coventry, Liverpool, and throughout the whole world, whether in Switzerland or England, are all interested in this effort of the Institute to improve the trade. For this purpose, we have a right to ask subscriptions not from our members only, but from the whole trade, so that we may be enabled to raise a sufficient fund, from which we may offer prizes which will tempt men of skill and science, in whose breasts now lie hid some of those secrets which belong to their respective departments—to treat of lever escapements for example; that we may be in a condition to present to them a bribe large enough to induce them to give to the world the valuable knowledge which they possess. We do not, however, seek to do this by the offer of pecuniary recompense, although that is, of course, a necessary part of the inducement; but by the general *éclat* and reputation they will attain in the trade, of having been the first authority in it in their particular specialty — an honorary distinction which would operate as a motive to stimulate emulation in the minds of all honourable people. We trust that before the time comes when we finally decide upon the amount of the prizes, that we shall receive contributions from all the different members of the trade, in all directions—such a sum as will enable us to tempt, not third or second, but first class merit to enter into a competition for them. The next matter to which I wish to draw your attention is the report which has been made by the Auditors, which I will read to you. It is a satisfactory report so far, that the statement of accounts laid before them as Auditors by the Finance Committee has been accepted by them as correct. The Council, however, would in some degree express their judgment, that the Auditors who have been appointed on behalf of the general body of the Members have, perhaps from inexperience, and a want of accurate knowledge of the limits which bounded the duty they were called upon to discharge, proceeded farther than others had done on previous occasions, and than the line ordinarily adopted by auditors in public institutions. The accounts of such bodies, you are aware, ought to be like Cæsar's wife, not merely above crime — (Mr. BROOKS: Hear, hear)—but even above the suspicion of crime. It is necessary that they should be conspicuously self-evident; that, in a manner, they should speak their own truth to everybody who looks at them.—(Mr. BROOKS: Hear, hear.) —But unfortunately for such a proposition, the Auditors have put some of their own figures, intermixed with the figures given them to audit by the Finance Committee, which, I confess, to my mind, has introduced a certain amount of confusion into the accounts. So far are they confused, that if it were my matter, I should no longer continue to look on them as containing a satisfactory, self-evident proposition of the statement of facts. But I do not know that the Council would have had much ground of complaint if the figures which the Auditors have interpolated had been always correct; but if the interpolation, or supposed correction of an error, be itself an error, then the Council have some reason to lament that the Auditors should have a little overstepped their duty.

The Auditors may read in one of the rules a definition of their duties, namely, that they "shall

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examine the accounts and vouchers previous to the next half-yearly meeting, at which they shall present their report." Now hitherto it has been the custom to lay the financial statement before the Auditors with an account of the receipts and disbursements during the preceding half-year, waiting for the yearly meeting for an account of the general liabilities and assets of the Institution. It has not been usual hitherto to submit a statement of assets and liabilities to every half-yearly meeting. It would have been, perhaps, more convenient for the Council, and especially for the Finance Committee, if they had known that the Auditors put such a construction upon the words "financial statement," to have submitted to the Auditors the whole materials from whence they might have judged correctly upon the matter, supposing that theirs had been the right rendering of the words of the rule. I repeat, that should the account of assets and liabilities have been really required to be presented to this meeting, that the Finance Committee should have known the desire, so that they might have submitted an exact and proper account to the Auditors, from which they might have judged rightly. The consequence has been, as we might naturally have expected, that the account of the liabilities and assets which the Auditors have placed in the wrong place, is not so correct as it would have been had they received fuller information. Again, there is a certain propriety in account-keeping, as in everthing else, and the Council, therefore, regret the insertion in the midst of columns of figures of a number of dates or words which are obstructions to the progress of the account, and render it necessary to have a re-entry of the account in another place. These are little irregularities which, perhaps, are attributable to the inexperience of the Auditors. I do not know that the Council would have felt it necessary to remark upon these irregularities except for the purpose of making known their objections to an interference with the accounts, which really amounts to an obstruction to the use of the books; for, as we understand it, an audit is not the actual destruction of the books from future use, but merely a record, making memoranda, and presenting a separate sheet as the result of their examination of the ledger. By this unusual step of the Auditors the book in which the entry of their statement has been made has been rendered inconvenient for future use. The ledger accounts are all of them obstructed by these subscriptions, by the words "audited," and the names of the Auditors, which in some degree materially deface the credibility of the accounts, and render them anything but a correct course of book-keeping. We only mention the matter that it may not be construed into a precedent, but that the usual plan of audit which has always been adopted from the earliest establishment of the Institute should be followed, and which has been invariably pursued until the present gentlemen became operators. I am sure, however, that from the balance sheet the whole of the trade will come to the conclusion that the affairs of the Institute are in a reasonably favourable condition; and that as regards the trade we have a right to expect that when things come to the worst they are sure to mend. There is every prospect before us that an amended condition is coming. One proof of that improvement is the fact that we cannot get our work back from workmen as we used to do three or four months ago, and there are general signs of people being more cheerful and hopeful of returning prosperity than they were some time back. We may reasonably suppose that people would be better able to pay up their subscriptions when they are prosperous than when their trade was depressed, although they ought to support the Institute even in the worst of times. Let us hope that we shall have before us better times, and that with them the Institute will become more prosperous and be able to do higher and better things than it has yet done. I know that there are some persons who ask the strange question, "What good is the Institute to me?" I have heard that question very pointedly put. One gentleman whom I invited to co-operate with it, met me with the same words. My answer was, that we are able to point to individuals who by the knowledge they have gained from the Institute, and the instruction they have received through the medium of the *Horological Journal*, have risen from being inferior escapement makers to the position of men capable of taking first-class work, changing their position from men who could earn some 30s. or 35s. a week to men who could command much more per week. There is a substantial good arising from the Institute, exclusive of the honour and pleasure of belonging to it. If such has been the experience of one individual, we may fairly suppose that the Institute has done similar good in many other ways which have not come to our knowledge. I beg to move the adoption of the report.

MR. BROOKS rose and said—Mr. Chairman and Gentleman: I was much pleased to hear that the Institute had nothing to smother; but I am somewhat surprised to find that, in referring to the Auditors' Report, you have smothered one-half of it, and also their remarks upon it. With all due deference to you, Sir, I maintain that according to the 14th Law, the Auditors are called upon to produce their report in the manner we have done. The rule does not say what report is to be presented, but it simply states "shall present their report." Now, if it were not so, a society might involve the members considerably in debt, and the members would be none the wiser about the state of their affairs, because the Council had taken care to keep a sufficient sum at their bankers for present purposes, so that every one taking part in the government of that society would find out their liabilities when they least expected it. We have had objections made to the British Bank auditors, as well as to those of the London and Middlesex Bank; and what has been the objection made to the auditors in each of these cases? Why, that they did not present a fair statement of assets and liabilities. Now, Sir, would you, on the Council, have smo-

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thered the other half of the report if the position of the Institute had been a little more favourable? There is the key to the cause of their being smothered. I must say that I have gradually altered my opinion of the Honorary Secretary; in particular, that he should lend himself to such an irregularity as this appears to me to be. I have a fair right to complain of this, and also that there are not half-a-dozen members here who are not on the Council, and there are not more than half the members of the Council present. I have a right to complain that the Chairman, whose duty I have always been taught to believe it was to judge impartially between all parties, should take upon himself to catechise the Auditors, and lay down the law, as though the Council were the only parties in this Institute who could define right and wrong. I maintain, Sir, that the Auditors were appointed by the members to decide between them and the Council. It is not amenable to the Council to claim, neither do we as Auditors submit, our report for their approval, but for that of the members only. As I stand here, if my words reach the public, I am quite sure, however I may be in a minority here, that I stand well with the world outside on this question. Our only desire is to show the world the proper position of the Institute, so that when the next annual meeting was held, the truth, the whole truth, and nothing but the truth, should be known to the members. I would not burke any particulars that might be asked for. I maintain, whatever may have been the practice in this Institute, that the account is not correct. There are some amounts not correct.

Mr BROOKS went into particulars to explain that the books did not show a proper posting up in some accounts, and that others appeared to balance, which were still open. I found, in reference to the bills, that there was an account of over £30 due to Tirebucks' and £29 12s. 6d. due to McDonald, making £59 12s. 6d. due to printers, and I suggested that these accounts should be properly posted up. When I entered the Institute to audit these accounts, from what I heard outside, I really thought that lowest amount you were in debt was £100, without any assets to meet it. I was very much pleased to find that such statements were untrue, and to find such a balance sheet as that we had to present to you. I could not conceive that you would be displeased with a mere statement of truth. I have no knowledge of entering anything in the books unless in the way of a ready reference. To do anything irregular was farthest from my thoughts. The Auditors found a sum of £41 18s due from members as subscriptions in arrear for periods varying from 1 to 3 years. Was it not right that the Council should be informed of that fact, and to furnish them with a list for reference.

The CHAIRMAN: There are members of the Council present who were fully aware of all this.

Again there is due for the Journal £27 15s., making a total of £71. 0s. 2d. The accounts owing were Tirebuck £24 19s. 6d., Mrs. Macdonald £29 12s. 6d., house £23 9s. 9d., Expenses £31 1s. 6d. Journal printing (Tirebucks') £6 7s. 6d., see balance due 6s. In Mr. Lee's account, instead of there being the entire amount due he is debited. If the Institute obtained the whole arrears due to it, it would have a balance of £2 1s. in its favour. I don't hold with disguise in the government of any society. Let its state be known from the accounts; let them be correctly done, but don't attempt to smother them. I never knew an instance in any society where the secretary took upon himself not to deliver the report of the auditors, but merely the half-yearly accounts, with a statement that we, as auditors, believed them to be correct. Mr. Brooks continued, with some interruptions from members and the chairman, to allege dissatisfaction with the council for the fact of many subscriptions being in arrear; also for his remarks at a former general meeting having been misreported in the Journal which was denied to be substantially true by the then editor, Mr. Strachan, who said, I feel it necessary to say a few words as to the Journal Committee having made any alteration in the speech of Mr. Brooks, or of any one else for the sake of misrepresentation. It was impossible, looking at the length of Mr. Brooks' speech, and the proceedings generally, to report them at full length; but that there was any wilful misreporting I utterly deny. Hearing of the allegation, I called upon a member of the Committee with the shorthand writer's notes, and asked him whether the omission made any difference in the speech, and he said that he did not see that it made any difference, and that there was no foundation whatever for Mr. Brooks' grievance.

I certainly afterwards received a communication from Mr. Brooks, complaining of the report of his speech, but this I did not notice, as I considered it altogether a piece of nonsense.

(To be continued.)

THE WATCH TRADE OF GENEVA.

Continued from page 59.

less unfavourable) will allow fair play to the industrious workmen and the enterprising watchmakers.

LAW ON TRADE MARKS.—The Canton of Geneva has lately passed a law making it matter of prosecution to fraudently use trade-marks of any kind, whatever may be the insignia adopted by the manufacturer. The adoption of a trade-mark is optional. The owner to deposit two copies of such mark with the Tribunal de Commerce of

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Geneva, and the proprietorship of it to be good for fifteen years, with power of renewal on making a second deposit. This precaution seems to be necessary, otherwise the parties aggrieved will not be able to lay their complaint before the Tribunal; for Article III. says, "Nul ne peut revendiquer la propriété exclusive d'une marque s'il n'a déposé deux exemplaires du modèle de cette marque au Greffe du Tribunal de Commerce." The present law may be considered as resulting from the literary and artistic Convention concluded with France at the end of 1858, as the XIXth Article expressly says:—

The contracting States, recognizing in addition the advantage of applying to the productions of industry, that protection afforded by the present convention to those of art and intellect, will henceforth hold trade marks, to be comprised in these latter, and therefore will assimilate their unjustifiable use to that of artistic and literary piracy.

Marks intended to identify the manufacturing property of those concerned with one or the other of the contracting parties, will be disposed of; as concerns the Geneva trade at the Board of the Paris Tribunal of Commerce; and as concerns French productions by the Genevese tribunal, authorized by the law to receive like depositions having reference to the Home Trade.

In the beginning of 1859, Geneva was willing to conclude a similar Convention with England, but, at the time it was not responded to. There can be no doubt that for our watchmakers, whose names are being constantly forged, not so much, perhaps, by Geneva as Neuchâtel, it would be very important to be able to lay hold of the offender before his own tribunals, and so tend to put a stop to an evil of which our people loudly complain.

In order to comprehend the whole bearing of the law, I give the original:—*

The Law on Trade Marks. (*April 5th*, 1862).

"Article 1. Manufacturing or trade marks are optional.

However, the law may exceptionally declare these obligatory for certain productions, which it will determine.

"Art. 2. The following shall be considered manufacturing or trade marks.

Names under a distinctive character, denominations, emblems, impressions, brands, seals, vignettes, relievos, letters, cyphers, envelopes, and all other indications serving to distinguish manufacturing productions or articles of trade.

"Art. 3. No one can claim exclusive property in a mark, unless he has deposited two copies of this mark with the Board of the Tribunal of commerce.

"Art. 4. This registration is not to have effect for more than 15 years. The right of property in this mark, may in all cases be renewed for a new term of 15 years by a new registration.

"Art. 5. They will be considered guilty of forging a manufacturing or trade mark,—

1. Who have forged this mark, or used a counterfeit mark.

2. Who have fraudulently placed on any productions or articles of trade, a trade mark belonging to another

3. Who have knowingly sold, or exposed for sale, articles bearing a counterfeit mark, or one fraudulently put on.

Art. 6. Those are liable to prosecution for an infraction of the law,—

1. Who without counterfeiting a trade mark, have used a fraudulent imitation, likely to deceive purchasers, or who have made use of a mark, a fraudulent copy.

2. Those who have made use of a mark of a nature likely to mislead a purchaser as to the character of any production.

3. Those who have intentionally sold, or offered for sale, productions bearing any fraudulent imitations of a trade mark, or having appearances likely to deceive a purchaser as to the nature of the productions.

Those who bring any action in virtue of this article of the law, must prove fraud or fraudulent intention on the part of the accused.

"Art 7. The offence of unlawful use of trade or manufacturing marks, as regards the prosecution, shall be considered as facts, whose object has been to deceive the purchaser as to the nature of the article sold, and will be liable to the penalties provided by the article 423 of the Penal code.

Art. 8. The Board shall not take action for facts connected with frauds upon manufacturing or trade marks, except at the instance of the parties interested.

Art. 9. Individuals whose manufacturing or trade mark has been counterfeited, may prosecute criminally, by laying their complaint before the Board, or simply bring an action for damages, assessed at the proportional injury received by the articles so fraudulently disposed of, before the ordinary Civil Tribunal.

* We have thought a translation of the original more acceptable to our readers. A similar Law has, within the last few weeks, come into operation in Great Britain.

BRITISH ASSOCIATION, NEWCASTLE-UPON-TYNE.

ON THE MANUFACTURE OF ALUMINIUM.

BY ISAAC LOWTHIAN BELL, MAYOR OF NEWCASTLE.

The progress of the manufacture of this—so far as the arts are concerned—

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new metal has scarcely been such as to require much to be added to those admirable researches bestowed upon the process by the distinguished chemist, M. St. Clare Deville, of Paris. Upon the introduction of its manufacture at Washington, three and a half years ago, the source of the Alumina was the ordinary ammonia of commerce — a nearly pure sulphate of alumina and ammonia. Exposure to heat drove off the water, sulphuric acid, and ammonia, leaving the alumina behind. This was converted into the double chloride of aluminium and sodium by the process described by the French chemist and practised in France, and the double chloride was subsequently decomposed by fusion with sodium. Faint, however, as the traces might be of impurity in the alum itself, they to a great extent, if not entirely (being of a fixed character when exposed to heat) were to be found in the alumina. From the alumina, by the action of chlorine on a heated mixture consisting of this earth, common salt, and charcoal, these impurities, or a large proportion thereof, found their way into the sublimed double chloride, and, once there, it is unnecessary to say that, under the influence of the sodium in the process of reduction, any silica, iron, or phosphorus found their way into the aluminium sought to be obtained. Now it happens that the presence of foreign matters, in a degree so small as almost to be infinitesimal, interferes so largely with the colour, as well as with the malleability of the aluminium, that the use of any substance containing them is of a fatal character. Nor is this all, for the nature of that compound which hitherto as constituted the most important application of this metal—aluminium bronze—is so completely changed by using aluminium containing the impurities referred to, that it ceases to possess any of those properties which render it valuable. As an example of the amount of interference exercised by very minute quantities of impurity, it is perhaps worthy of notice that very few varieties of copper have been found susceptible of being employed for the manufacture of aluminium-bronze; and hitherto we have not at Washington, nor have they in France, been able to establish in what the difference consists between copper fit for the production of aluminium-bronze and that which is utterly unsuitable for the purpose. These considerations have led us, both here and in France, to adopt the use of another raw material for the production of aluminium, which either does not contain the impurities referred to as so prejudicial, or contains them in such a form as to admit of their easy separation. This material is Bauxite, so called from the name of the locality where it is found in France. It contains—

Silica	2·8
Titanium	3·1
Sesquioxide of iron	25·5
Alumina	57·4
Carbonate of lime	0·4
Water	10·8
	100·0

The Bauxite is ground and mixed with the ordinary soda-ash of commerce, and then heated in a furnace. The soda combines with the alumina, and aluminate of soda so formed is separated from the insoluble portions, viz., peroxide of iron, silico-aluminate of soda, &c., by lixiviation. Muriatic acid or carbonic acid is then added to the solution, which throws down pure alumina. The remainder of the process is precisely that which is described by Mons. St. Claire Deville. The alumina is mixed with common salt and charcoal, made into balls the size of an orange, and dried. These balls are placed in vertical earthen retorts, kept at a red heat, and through the heated contents chlorine gas is passed. The elements of the earth, under the joint influence of carbon and chlorine at that temperature, are separated—the carbon taking the oxygen, and the chlorine the aluminium. The latter substance, accompanied by chloride of sodium (common salt), sublimes over, and is collected, as a double chloride of aluminium and sodium. In small iron retorts, kept at as high a temperature as iron can bear, a mixture of soda (carbonate of soda), and carbonaceous matter, with a little ground chalk is placed. The metallic base of the alkali distils over and is collected in coal oil. A portion of the double chloride and sodium, along with fluxes, is exposed to a full red heat

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in a reverberatory furnace. The sodium seizes the chlorine combined with the aluminium, and thus liberates the latter metal, which falls to the bottom of the fused mass.

Aluminium is used in sufficient quantity to keep the only work in England, viz., that at Washington, pretty actively employed. As a substance for works of art, when whitened by means of hydrochloric and phosphoric acid, it appears well adapted, as it runs into the most complicated patterns, and has the advantage of preserving its colour, from the absence of all tendency to unite with sulphur, or to become affected by sulphuretted hydrogen, as happens with silver.

A large amount in the increased activity in the manufacture referred to is due to the exceeding beauty of the compound with copper, already spoken of, which is so like gold as scarcely to be distinguishable from that metal, while it possesses the additional valuable property of being nearly as hard as iron.

This alloy, or aluminium bronze, as it is termed, is a discovery of Dr. John Percy, F.R.S., and appears to be a true chemical compound. Copper is melted in a plumbago crucible, and after being removed from the furnace, the solid aluminium is added. The union of the two metals is attended with such an increase of temperature, that the whole becomes white hot, and unless the crucible containing the mixture is of refractory material, a vessel which has resisted a heat sufficient to effect the fusion of copper melts, when the aluminium is added.

Mr. Gordon was the first, it is believed, who detected and determined the amount of tension wire of aluminium bronze was capable of resisting, which he found to be between that of the best iron and the best steel wire. Colonel Strange, of the Royal Astronomical Society, investigated its properties, which were given in a very able paper in the transactions of that body. Its malleability, ductility, and capability of being finely divided and engraved upon, along with its great strength, induced the Colonel to recommend its adoption in the theodolite used in the Trigonometrical Survey of India.

At the Elswick Ordnance Works, Captain Noble, R.A., confirmed previous experiments on the capability of aluminium bronze to resist longitudinal and transverse fracture, and in addition to this he ascertained that its position to withstand compression stood halfway between that of the finest steel and the best iron.

The bronze, containing ten parts of aluminium and ninety of copper, affords an alloy endowed with the greatest strength, malleability, and ductility. The colour of the copper is affected by a very trifling addition of the other constituent, and the alloy gradually improves in those valuable qualities just mentioned until the proportions given above are reached. After this, *i.e.* when more than ten per cent. of aluminium enters into the composition of the bronze, the alloy gradually becomes weaker and less malleable, and at length is so brittle that it is easily pounded in a mortar.

THE CHRONOMETERS OF THE IMPERIAL FRENCH MARINE.

PROGRAMME OF THE CONDITIONS FOR QUALIFYING, PURCHASING, AND REPAIRING CHRONOMETERS INTENDED FOR THE FRENCH NAVY.

In consequence of a proposition by the Director of the Imperial "Sea Chart Depôt," an order by the Marine Minister, dated November 18th, 1857, was issued, to come into operation January 22, 1858, with the following programme:—

1st Article.—Chronometers manufactured in *France* will be admitted for compe-

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titive trial at the Sea Chart Depôt, and bought after a trial of three months, during which time the chronometers will be exposed to a temperature of from 5° to 30° "Reaumur"?

2nd Article.—The greatest variation in mean temperature, added to the greatest variation or difference observed in the above extremes of temperature, gives for every chronometer a number N, which serves as its classification number. The chronometer, for which this number does not exceed three seconds, will be considered qualified, and bought for the navy at the fixed price of 2,000 francs—£80.

4th Article.—Amongst those chronometers sent in for trial the same year, the one that stands first in order of merit will further receive a premium of 1,200 francs—£44., providing the classification number N. does not exceed 2½ seconds.

5th Article.—Repairs, cleaning, and applying of fresh oil, not taking into account extent or kind of repair, will have to be done at an average rate of 80 francs —£3. 4s.—each. The makers of the respective chronometers should, by rights, be preferred for their repairs, except they positively decline, when the instruments will be confided to *other artists* for repairs or examining. Every repaired chronometer which, after a trial of one month at the Sea Chart Depôt, in conformity with the rules in Article 1st, reaches a number N. not exceeding two seconds, receives, in addition, a premium of 200 francs—£8.

6th Article.—In accordance with the 23rd Article of the Finance Law of the 8th July, 1852, three per cent. will be deducted from the payments specified in the above programme, in favour of the Marine Invalide Fund.

The Imperial Navy has for the moment (1858) 300 marine chronometers and 100 compteur chronometers, "*or observation watches,*" whose value is considered to amount to 800,000 francs. For additions and repairs 50,000 francs yearly is set aside.

(Abstract from "Projet d'organisation du Service des Chronometres appurtenant a la Marine," par Lieusson, Ingineur Hydrographe de la Marine, Officier de la Legion d'Honnéur, Depot General de la Marine, by L. U. Jürgensen, Copenhagen.)

[We insert the above, in order to show the quality of the test as applied in France to marine chronometers. A cursory comparison with our own far more severe tests will prove at once that chronometry, as a science, has not attained the perfection in France that it has in England—the writer of "Contemporary Horology" notwithstanding.—ED. H. J.]

At the monthly meeting of the Royal Astronomical Society, on Friday, the 8th January, Lieut.-Col. Strange described a very nice horological addition to the transit, the invention of M. Redier, of Paris, consisting of a slide carrying the eye-piece, and a travelling wire moved by a chronometer at the exact rate of the motion of a star, with excellent adjustments for making the wire coincide with the star under observation, and to make it travel at the same rate. A stop attached to the chronometer enables the observer to mark the instant of coincidence between the travelling wire and the meridional wire of the transit instrument, by stopping a hand marking fractions of seconds, but without stopping the chronometer; so that comparison may be made between the instant of stopping and the observatory regulator. Observers speak well of it.

TO THE EDITOR OF THE HOROLOGICAL JOURNAL.

SIR: In a recent article in the Journal, entitled "Contemporary Horology," the writer, after a lively sketch of the history of Horology, which he concludes to his own satisfaction with the statement that this art is of French origin, growth, and perfection, proceeds to demolish, *in assertion*, any claim British inventive genius may heretofore have made to advancing this science, by the contribution of the original application of natural laws or mechanical principles to the improvement of the timekeeper. Upon this branch of his subject I do not propose to comment, for the illustrious names of men who have advanced and benefitted Horology stand out as landmarks in its progress too historically to admit of doubt to any student anywhere. I need only allude to such men as Dr. Hook, Harrison, Graham, Mudge, Arnold, Earnshaw, and some more recent names, in evidence of this. Not satisfied with this depreciation, by obliviousness of the work of eminent British watch-makers and inventors, the writer solemnly averring that his statements are made after the "most careful researches; the most active investigations" says the English watch, "*sui generis*, is scarcely more than a myth,"—an extraordinary

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exception. After so unqualified an assertion, we should expect, at least, he would adduce some evidence—as indeed he states he will. Instead of informing the reader by statistics how few and far between are the productions of British manufacture, he winds up by citing less than a dozen distinguished foreign names settled among us, whose merit is unquestioned, but who I am sure in many, if not in most instances, would repudiate the assertion that English workmen had not assisted, to a very considerable extent, in the production of their *chef d'œuvres*. The utter refutation and disproof of this writer's assertions as to the state of British Horological manufacture is so simple, and, in fact, as indicated, exists in the very number of the Journal containing his mis-statement, that it may appear to be a work of supererogation to adduce further proofs; but, for his information, we may be able to show that the complaint he makes, of having been "taken to task last year, and vehemently accused of mis-statement, misrepresentation, and ignorance," in reference to some other strictures on British productions, is undeniably true in the widest sense in reference to his present assertions. Moreover, by the official return published in the last Journal of the average production of Geneva, he may learn with surprise that the production in that city falls considerably below our own in quantity, and, we should add, still more so in absolute value. By the returns we have furnished by order of the House of Commons, the Goldsmiths' Hall exhibits an average,—during the six years up to April 30, 1860—of 24,489 gold, and 90,922 silver watches produced annually in London, or a total annual average of 115,411 cases marked. If from these we deduct say 1-10th for gold cases for Coventry watches—and, I believe, only the best class of their work is supplied with London gold cases, their staple being known to be cheap work—we should have 112,963 as against the Geneva returns of 60,000 annually, or nearly two to one in our favour. I take not into account uncased watches, of which considerable numbers were annually sent to America from both London and Liverpool, and which would swell this total. For the year ending April 30, the return is—

1855	Gold cases marked	20,817
1856	do.	22,931
1857	do.	26,796
1858	do.	24,870
1859	do.	24,556
1860	do.	26,966

or an average for the 6 years of gold 24,489.

April 30,	1855	Silver	90,062
„	1856	„	96,261
„	1857	„	106,860
„	1858	„	83,614
„	1859	„	78,416
„	1860	„	90,320

or an average of 90,922 silver cases marked annually. Very possibly the writer—entering upon the career opened to France by free trade, introduced by the sagacity of its present ruler and by Mr. Cobden's negotiations—may, with French vivacity, have seen what he wished should be for what *really* exists. But I believe he may be told that should L'Empire mean really peace and civilization, not retrograde by an era of war being inaugurated, there is room in the world for each country's productions, and scope for the new-found enterprise of a manufacture really almost lapsed in Paris. As the writer can have evidently access to British sources of information, this article having been reprinted in a newspaper published in London, I think we cannot do better than recommend him to become a founder to our Institute: his information may then be more accurate, and he may contribute to our Journal, perhaps, by the aid of his fluent pen, furnished with data of a less questionable character.

S. J.

NOTICE TO MEMBERS AND FRIENDS.

The Council of the Horological Institute have much pleasure in announcing that the Portrait of the late THOMAS EARNSHAW has been added to their Collection, and now adorns the walls of the Reading Room.

They beg further to bear testimony to the admirable manner in which *Mr. Bellin* has copied, on steel, the original Portrait by Sir M. A. Shee. Of this the Members and their friends may judge by an inspection, to which the Council hereby invite all.

Proof Impressions may be obtained only by applications at the Office of the Institute, price 10s. 6d.

We venture to affirm that this Engraving will bear favourable comparison with that of any English Horological worthy ever published. ED.

OBITUARY.

We have to record, in our Obituary, the death of a gentleman, recently a Member of the Institute, Mr. Thos. Cole, brother to our Ex-Vice-President, who died on the 3rd ult., after a very short illness. As a maker of portable clocks, combining excellent mechanical principles with unexceptionable taste in design, and the adapter of horological and other machinery to articles of drawing-room and other use, he stood without a rival here for design, taste, and execution, and this was allowed where, in this branch of the art, few English workers would attempt competition. Our neighbours, at the Paris Exhibition of 1855, accorded him a very distinguished position for true artistic excellence and superior workmanship. The void made by his decease, in this particular manufacture, will, unless by his sons, with difficulty, if at all, be filled up.

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METEOROLOGICAL OBSERVATIONS

Taken at 9 A.M., DECEMBER, 1863.

11, *Offord Road, N.*

Day of the Month.	Barometer, at 32° F. and mean sea level	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	inches.	°	°	°	°				
1	29·858	42	41	42	32	SSE	4	om	orq
2	·016	50	48·7	50	41	S	6	o	r,bc,rrqq
3	·072	46	44	53	38	W	10	c	bcqqr
4	30·360	36	34·7	47	32	W	5	bc	bc
5	·167	49	46	49	35	SW	8	o	c, r
6	·276	40·5	39·5	51	39	SW	4	o	bc
7	·393	47·5	46	47·5	39	SW	4	c	cb, o
8	·195	48	45·5	51	47	SW	6	o	o
9	·042	49·5	49	50	47	SW	5	r	r, b
10	·241	39	38	51	36	WSW	4	c	c, o
11	·276	45·5	44·5	46·5	38	WSW	3	o	om, cq
12	·152	49·5	47·5	51	46	W	4	c	bc
13	·417	40	39	53	38	WNW	2	bm	bc, m
14	·458	38	37	48	36	WSW	2	ff	m
15	.400	44·3	43	47·5	37	W	2	m	f, m
16	29·924	48	46	48	43	SW	2	o	o, b
17	·900	44	40	49	36	NW	6	o	c, b, m
18	30·485	36	34	45	32	NNE	3	c	om, m
19	·509	43	42	43	34	NW	1	f	f, m
20	·397	40	39	47	36	W	2	om	o, m, r
21	·212	43	42·5	43	37·5	NW	1	om	o, b, qr
22	29·866	46	43	48	41	N	7	o	o, b
23	30·112	36	35	46	27	W	5	o	o, b
24	·220	43	42	47	35	WSW	2	o	o, cb
25	·291	47	46	48	42	W	3	cb	cb, b
26	·062	49	48	49	41·5	SW	4	om	om, bc, r
27	·010	42	39	51·5	41	WNW	4	bc	bc, m
28	·356	34·5	32	42	30	N	1	m	m3, o
29	29·989	49·5	48	50	33	WSW	5	o	qc, r, bc
30	30·162	41	40	51	40	WSW	2	c	c, f
31	29·927	36	35	45	30	E	2	f	o, r
	30·121	43·3	41·8	48·1	37·4		4	Mean	

REMARKS.

The greatest atmospheric pressure observed was 30·509, inches at 9 a.m., 19th; and the least, 28·984 at 8 a.m., 3rd; so that the range of pressure amounted to 1·525 inches.

About 1 p.m., 2nd, a gale of extraordinary severity commenced with a sudden change of wind from S. to W. Towards night the wind veered to N. with unabated force. Next morning the wind was W.; and between 8 and 12 a.m. it blew with unprecedented force in the squalls. The gale lasted until past midnight of the 3rd. On the 2nd 0·63 inch of rain fell.

On the morning of the 22nd there was a gale from W. to N.

There was rain on 9 days, during about 52 hours, to the amount of 1·32 inches.

According to the 9 o'clock observations, there were N. winds on five days, E. one, S. seven, and W. eighteen.

The pressure and temperature have been above the average values, with a great range in the barometer and only seven frosty nights. The prevalent winds were W., those due to the month, and they were unusually strong. The rain-fall was below the average.

During the year 1863, the rain-fall amounted to 20·29 inches, which is 5 inches less than the average quantity. There was rain on 150 days; and the total duration, by estimation, was 667 hours. Hence, if the rain had fallen continuously, it would have lasted nearly 28 days; whereas, in 1862, a similar estimate gave 38 (see p. 74, vol. V.)

According to the 9 a.m. observations, for every calm noted, in 1863, there were 5·8 N. winds, 4·2 E., 7·1 S., and 12·3 W. The average force of all the winds was 3·2 of the "Sea Scale" for estimation. These results are almost identical with those for 1862.

INDICATIONS FOR FEBRUARY.—The sun is above the horizon on the middle day about 10 hours. The average *highest* temperature is 45°, *lowest* 33°. The barometer averages 29·96 inches, with a mean monthly range of 1·2 inches. The predominant winds are from S. to W.; bringing rain, on 10 days, to the amount of 1·6 inches; while there are usually about 10 frosty nights.

EQUATION OF TIME TABLE.

For February, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *added* to Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Mon . .	1	13 49 . 29	0 . 345	13 49 . 21
Tues . .	2	13 57 . 15	0 . 311	13 57 . 08
Wed . .	3	14 4 . 23	0 . 278	14 4 . 16
Thurs .	4	14 10 . 50	0 . 245	14 10 . 44
Fri . . .	5	14 15 . 96	0 . 211	14 15 . 91
Sat . . .	6	14 20 . 62	0 . 178	14 20 . 58
Sun . .	7	14 24 . 48	0 . 145	14 24 . 45
Mon . .	8	14 27 . 54	0 . 111	14 27 . 52
Tues . .	9	14 29 . 78	0 . 077	14 29 . 76
Wed . .	10	14 31 . 22	0 . 044	14 31 . 21
Thur . .	11	14 31 . 87	0 . 011	14 31 . 87
Fri . . .	12	14 31 . 73	0 . 022	14 31 . 74
Sat . . .	13	14 30 . 81	0 . 055	14 30 . 82
Sun. . .	14	14 29 . 12	0 . 086	14 29 . 14
Mon . .	15	14 26 . 67	0 . 118	14 26 . 70
Tues . .	16	14 23 . 46	0 . 149	14 23 . 49
Wed . .	17	14 19 . 53	0 . 179	14 19 . 57
Thurs .	18	14 14 . 86	0 . 209	14 14 . 91
Fri . . .	19	14 9 . 49	0 . 238	14 9 . 55
Sat . . .	20	14 3 . 44	0 . 267	14 3 . 50
Sun . .	21	13 56 . 70	0 . 295	13 56 . 77
Mon . .	22	13 49 . 31	0 . 321	13 49 . 38
Tues . .	23	13 41 . 28	0 . 347	13 41 . 36
Wed . .	24	13 32 . 63	0 . 373	13 32 . 71
Thurs .	25	13 23 . 38	0 . 398	13 23 . 47
Fri . . .	26	13 13 . 56	0 . 421	13 13 . 65
Sat . . .	27	13 3 . 18	0 . 444	13 3 . 28
Sun . .	28	12 52 . 26	0 . 466	12 52 . 35
Mon . .	29	12 40 . 82	0 . 487	12 40 . 92

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BRITISH HOROLOGICAL INSTITUTE.

ELEVENTH HALF-YEARLY MEETING.

Continued from Page 66.

Mr. W. Hislop, Hon. Sec., said that the course pursued by the Auditors was contrary to the regular usage. A statement of assets and liabilities was not required by the laws; but at the last annual meeting such a statement was placed on the table for the information of members, of which he had a copy in his possession. The Finance Committee, whose duty it is to prepare such statements, took no steps for the publishing of such a statement at this time, neither did he ask them to do so. After all the reports that had been made by those unfriendly to the Institute, about matters being suppressed or kept back by those who had the management of the Institute, persons who knew nothing of the facts would suppose, from listening to Mr. Brooks' remarks, that the Council had been guilty of some serious crime, or were endeavouring to injure others following the same pursuits as themselves, but he considered that the Council and its executive officers had no cause to be ashamed of their management, for those who made these statements knew well that nothing whatever had been suppressed, but everything on the contrary was sought to be made as open and plain as possible. The Chairman has already pointed out that had a statement of assets and liabilities been required it would have been the duty of the Finance Committee to prepare such. He was surprised to hear from the clerk that the Auditors had taken this unusual step, and he at once pointed out to them that it was contrary to the mode of proceeding heretofore adopted. He did this by letter, and Mr. Brooks had actually sent that letter to the local paper without asking his consent. Under these circumstances he could have nothing further to do with the Auditors. Mr. Brooks has complained of the books not being prepared for the Auditors in the way he wished. If they had previously asked him to have had them prepared according to their own ideas, he would have done so, although he would have felt it to have been unnecessary.

Mr. G. H. Webb.—As a member of the Finance Committee I feel myself censured by the observations of Mr. Brooks. I do not mean that they apply to me personally in particular, but only as a member of that body. I have been connected with it upwards of eighteen months, and during that period its members have endeavoured faithfully to perform the duties assigned to them as a committee. When we were called upon to produce the accounts for the auditors for that half year, I was led to understand that it was merely for the purpose of auditing the receipts and disbursements for that period, and that the assets and liabilities were only to be gone into at the yearly meeting of the Institute. Of course had we been led to believe that we ought to have provided the Auditors with any other materials for their audit, we should have applied to the Honorary Secretary for the details of the required information, but that not being the case we merely looked at all the various accounts. The members of the Finance Committee, I suppose, are the parties interested with the examination of the accounts; to see that all the moneys of the Institute are properly applied; to separate the accounts and payments due from and to it; and to see that all the tradespeople are properly paid, as far as the assets will go. At the end of the financial year a correct account should be prepared of the assets and liabilities; and then, and then only, should be the time to give the members the information that is necessary to enable them to judge of the actual financial position of the Institute with regard to assets and liabilities, as well as receipts and disbursements. I must say that I felt somewhat annoyed when I found that the labours of the Finance Committee had been somewhat called in question; because, although the labours of its members are not much, yet there still is some little responsability attaching to them. When they meet, they have a certain amount of business to perform; very probably had I been more constant in my attendance as a member of the Council, I should have obtained more information as to the necessary duties to be performed at the audit; but, unfortunately for me, I have not time to attend all the meetings of the Council, and that arises entirely from other engagements which press on me in the evening. I have endeavoured to come over here on notice meetings, as far as lies in my power, to promote the interests of the Institute, by devoting what time I can as a member of one of its committees to the transaction of its business. My labours have been honestly given, if they have not been as well received as they ought to have been, and as productive of as much good as they might be.

Mr. Brooks here interposed, saying that the Auditors had uttered no complaint, nor attached any blame to the Finance Committee, but stated it as his opinion that it was the duty of the Secretary, and of him only, to see that the accounts were correct and ready for the audit.

Mr. Klaftenberger rose to correct a misstatement, made by Mr. Brooks, in reference to the subscriptions in arrear having been neglected to be called in, and said, that having presided at nearly all the meetings of the Council, he could

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say that they had devoted a great deal of attention to this matter, having sat on one occasion till half-past eleven on this business only, while individual members of the Council had personally engaged to pay, or to obtain payment, of some of these arrears. It is to be regretted that members will not inquire into facts before making such statements and publishing them through the press. But the fact is, as I have said before, some of our members will not allow their apples to grow sweet, they persist in gathering them sour, distributing such among the members. Such men I consider do a great deal of harm to the Institute, by prejudicing the minds of people out of doors, leading them to suppose that we cannot agree among ourselves, which feeling has been aggravated by the imputations and personalities indulged in here by Mr. Brooks and others.

Mr. BLACKIE confirmed the statement made by Mr. Klaftenberger, as to the trouble taken by the Council personally to collect the arrears of subscriptions, and of the pains and expense Mr. Klaftenberger had been at on this account; and he thought that if Mr. Brooks would give his assistance and judgment to the Institute, he would set a better example than by publishing statements out of doors as to the Council having anything to conceal, which he must know is not the case. We sit here to be shown our errors of management, whatever they may be, but in different language and by different means to those Mr. Brooks is addicted to the use of.

Mr. MYLNE said, that for the first twelve months of the existence of the Institute the laws required the Auditors to furnish a statement of assets and liabilities, but that rule was altered, and subsequently at the half yearly meetings it merely required from the Auditors a statement of receipts and expenditure. The Auditors putting such a forced construction on the audit was unfair to the Secretary as well as to the Finance Committee. Their statement of assets, &c. being incorrect ought not to be published.

Mr. STORER said, that having been constant in his attendance at the meetings of the Council, he could truly testify to the good feeling and strong desire, on the part of many gentlemen in it, to meet the wishes of the members and to guard their interest as much as possible.

The adoption of the Report was then moved and carried unanimously.

ELECTION OF HON. SECRETARY AND MEMBERS OF THE COUNCIL.

Scrutineers.—Mr. PRICKETT and Mr. BROWNING were nominated to this office to report upon the result of the ballot.

Their Report was handed to the Chairman to read, and was as follows:—

As Hon. Sec., Mr. S. Jackson; as Members of Council, Mr. J. T. Murray, Cornhill; C. Lange, Salisbury Street, Strand; W. Dempster, Clerkenwell Green; H. Bickley, Half Moon Street, Barnsbury; A. Guye, Guildford Street, W.C.; W. Hislop, St. John Street Road.

ELECTION OF HONORARY MEMBERS.

Mr. GLASGOW proposed the election of Mr. John Hartnup, of the Observatory, Liverpool. He (Mr. G.) knew nothing of Mr. Hartnup personally, but as a public man, he felt that the Institute would be honoured by associating the name of Mr. Hartnup with it. As a public man he was well known to them all.

Mr. STRACHAN in seconding the proposition, said, As the astronomer of the Liverpool Observatory, one of Mr. Hartnup's primary objects had been to promote, as far as he possibly could, the perfection of the chronometer, which he had studied for a series of years; and the success with which he had pursued that object they were more or less familiar with. At the Liverpool Observatory there was a special arrangement for testing the chronometer, more than there was at Greenwich. Mr. Hartnup had also been successful in measuring and improving the balance for chronometers, as all makers of that instrument were aware. The interest he took in the diffusion of time through the port of Liverpool; the information he gave regarding chronometers to the captains of ships; the pleasure he took in promoting the interests of the chronometer makers; and his great courtesy and kindness in giving every facility, information, and instruction to all who applied for it, was beyond all praise.

Mr. BROOKS in rising disclaimed any intention of throwing a sour apple among them. They were about to elect a gentleman who did a great deal for the trade, although not much for the Institute; but while doing so, they should not forget those who were the mainstays of the Institute in its early days. There was a gentleman connected with them who stood out pre-eminent in the art, who had served the Institute as a Vice-President, who had never considered it a trouble to aid the members, either by lectures or by the production of models. He alluded to Mr. James Ferguson Cole, and amongst their members none had served the Institute better than he.

Mr. BLACKIE said that Mr. Brooks found fault with members for that which it was in his own power to remedy, as it was as open to him to nominate Mr. Cole a Honorary Member, as to Mr. Glasgow to take the course he had. He thought Mr. Brooks had not chosen the best time to introduce this suggestion. In addition, he (Mr. B.) understood Mr. Cole was not wishful for an honour of that kind.

The CHAIRMAN thought Mr. Cole being a Member would be a bar to his election.

Mr. BROOKS said that was not so. He had not proposed Mr. Cole as a Honorary Member, thinking that from a Member of Council, or Vice-President it would come better.

Mr. STRACHAN and Mr. GLASGOW thought the proposal at present before them need in no way prejudice the claims of Mr. Cole upon their consideration. Mr. Glasgow added, that he was under the impression Mr. Cole was a Honorary Member. He thought if Mr. Brooks had the interest of the Institute at heart, the selection of

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an opportunity to bring forward his propositions was unfortunateiy ill-judged, and seemed to turn out the worst means he could adopt to serve it. If Mr. Brooks had brought forward the name of Mr. Cole for this nomination, he should have been heartily glad to second it, for he thought Mr. Brooks's long connection with the Institute made him quite the proper person to propose this.

The resolution being put, Mr. Hartnup was declared to be unanimously elected a Honorary Member.

ELECTION OF AUDITORS.

Messrs. Gunton, Marriott, and Evans were proposed, and unanimously elected to be Auditors.

The CHAIRMAN announced, with some regret, that owing to a bereavement, Mr. Jackson had been prevented accepting the office of Honorary Secretary to which he had been just elected. It would therefore be the duty of the members to appoint another successor to Mr. Hislop.

In reply to inquiries made, Mr. Hislop stated that from the necessity of immediately nominating a Member as Honorary Secretary, there had not been time to consult Mr. Jackson. He was sorry that he could not accede to Mr. Klaftenberger's appeal to remain in office till a successor was appointed. He had consented to continue three months longer, to allow time for the election of a successor. He had already been in office 2½ years, and he was utterly unable to perform the duties of the Honorary Secretaryship, and he found it improper and impossible to hold that position even temporarily.

At the suggestion of the chairman the matter was referred to the Journal Committee.

MEETING TO RECEIVE THE REPORT OF COUNCIL ON A REVISION OF THE LAWS.

On the motion of Mr. Blackie, seconded by Mr. Storer, it was unanimously resolved that a speeal meeting, for the above object, be held on the third Monday in March, and that a notice thereof, published on the cover of the Horological Journal, be deemed a sufficient intimation to the Members.

VOTES OF THANKS.

Mr. HEWITT moved a vote of thanks to the Council and all the officers, except the Auditors. Mr. Browning, as one of the Auditors, thought that what he had done was his duty, and in no way to the injury of the Institute or the Council.

Mr. BLACKIE.—I move a vote of thanks to the Auditors as well. All men are liable to errors. Mr. Brooks has expressed regret on the part of the Auditors, and we ought to accept that expression of regret.

Mr. BROOKS.—I did nothing of the kind. The Auditors are quite convinced they have done their duty. They have no desire to accept a vote of thanks at the hands of the Council. Mr. Brooks continued at considerable length to animadvert upon the remarks made upon the Auditors, justifying the course he had taken, and said, he had been personally ill-treated by members of the Council. He was here interrupted by an appeal to the chair to prevent such irregular observations. The Chairman requested Mr. Brooks to avoid personal and offensive remarks, and confine himself to the question before the meeting— the vote of thanks to the Auditors. Mr. Brooks concluded by saying that, if any inaccuracies had existed in the auditing of the accounts, it had not been for want of care or time devoted to their duty, as they had spent a day and a half over the audit, and could only take the accounts as they found them in the books of the Institute, and the information which they had to ask from the clerk only.

VOTE OF THANKS TO THE HON. SECRETARY.

Mr. WEBB.—I trust we shall not leave without recognising the services of a gentleman who has served the Institute for a long time, as faithfully and as usefully as any man ever did. The whole of the members must feel pleased that a vote of thanks has been tendered for his acceptance. I only regret that our recognition of Mr. Hislop's services has not taken a more substantial form.

Mr. KLAFTENBERGER having seconded the motion, it was carried unanimously.

Mr. HISLOP.—Gentlemen, I beg to thank you once more for this your acknowledgment for what I have done for the Institute. I am sorry that circumstances prevent me from any longer taking the active part in its affairs that I have done for some time past, but, I know that I shall be believed by the majority of you when I say, that on retiring from the office no alteration of feeling in behalf of the Institute exists on my part, either as to its desirability or the amount of good it is calculated to do. It is a source of deep regret to me that the members, from some unfortunate cause, have not worked well together. Instead of laying aside those feelings which they too often pick up in the battle of life, working together for the common good, they rather seek to criticize each other's ways and deeds than endeavouring to make the best of them. I have always found in societies of this kind that all chance of doing good is utterly lost unless we work together and pass over a great deal, and do what good we can at our own expense. Let us do our utmost for the common object. This I have sought to do. I have endeavoured to conciliate all parties. I shall be borne out in this statement by my colleagues. If I have failed in my duties it has not been for want of a desire to bring all parties together. I have asked some who have remained out of office to come in. Some have accepted my invitation, and others have declined to do so. At the present moment we should be doing very much better in looking solely to the welfare of the Institute, instead of engaging in personalities as I have found, to my great sorrow, we have been engaged in to so great an extent. As long as I have life and strength I certainly will work for the benefit of the Institute and the whole trade. This Institute may fail and fade, and another may be established in its place, but so long as I can I will work for the

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promotion of the high objects of the Institute. In the meantime I am committed to this particular Institute, and so long as I can assist its internal working, and the thing is perfectly straightforward, whatever may be said, and whatever false intepretations may be put upon my actions, I shall seek to promote its prosperity. I regret that my friend Mr. Jackson, from the circumstance mentioned, was unable to be present, and take upon himself the special duties to which the members have elected him; but I hope that in a short time he will be able to take a position for which he is so well qualified. Specially naming certain gentlemen, such as Mr. Jackson, Mr. Strachan, the members of the Financial and Journal Committees, I beg to thank you once more for all your kindness, and of this fresh proof of it, for the exertions I have made for the benefit of the Institute.

VOTE OF THANKS TO THE TREASURER.

Mr. HISLOP.—I beg to propose a vote of thanks to a gentleman who has been essentially one of the best friends of the Institute,—our Treasurer, Mr. Blackie.

Mr. KLAFTENBERGER seconded this, and it was carried unanimously, and appropriately acknowledged by Mr. Blackie.

A vote of thanks to the Press was proposed by Mr. Strachan, who coupled with it the name of Mr. Farmer as one who had always evinced the greatest interest in the prosperity of the Institute. This was carried unanimously, and suitably acknowledged by Mr. Farmer.

A vote of thanks having been carried by acclamation to the Chairman, the proceedings terminated.

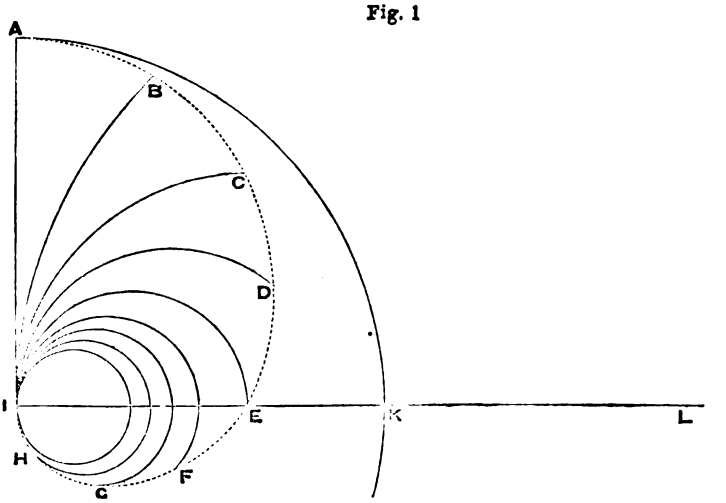
In our last No., Mr. Strachan is reported to have said, "I received a communication from Mr. Brooks, &c.," whereas it should have read, "I certainly *saw* a letter from Mr. Brooks, complaining that he had been mis-represented, but as it was not addressed to me, I did not notice it."

BALANCE COMPENSATION WEIGHTS.

TO THE EDITOR OF THE HOROLOGICAL JOURNAL.

SIR,—On reading the valuable report of the Jury for the International Exhibition of 1862, it occurred to me that the curve described by the weights of a compensation balance, in their approach to or recession from the centre of the balance, had never been satisfactorily shown. This led me to investigate the subject, and the following are the results of that investigation.

Fig. 1



Let A I be a straight compound bar of brass and steel, similar to the rim of a compensation balance, with the brass to the left. Let this bar be fixed at the point I, and omitting the longitudinal expansion of the steel, let us trace the curve described by the point A. From centre I, at distance I A, describe the circle A K; draw I L at right angles to A I. Now, all parts of the compound bar being equally affected by caloric, it will form itself into an arc of a circle varying according to the degree of heat applied; and the point I being fixed, the end A will travel in the direction A K. Let us find the point where A has travelled to when A I is bent by heat to an arc of 45°. Let the length A I be l and π as usual 3.14159, then as $8 \times 45° = 360°$, so $\frac{8l}{\pi}$ = diameter of circle of which A I is an arc of 45°. The point I being fixed,

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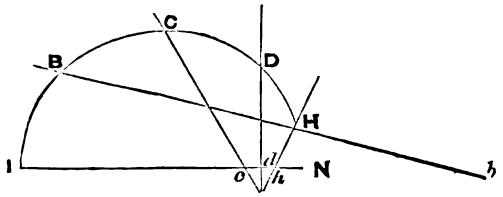
if, with centre on the line I L and diameter $\frac{8l}{\pi}$ an arc of 45°, I B be struck from the point I, then B will be a point in the curve. Again, with increased heat A I will bend to an arc of 90° Now, $4 \times 90° = 360°$ therefore $\frac{4l}{\pi}$ = diameter of I C. With centre on the line I L, with diameter $\frac{4l}{\pi}$, and from the fixed point I, describe an arc of 90°, then C will be another point in the curve. Again, the diameter of a circle, of which the length A I forms an arc of 135°, will be $\frac{8l}{3\pi}$. Proceed as before, and D will be another point in the curve. Again, 180° will give $\frac{2l}{\pi}$, by which the point E is found; 225° is $\frac{8l}{5\pi}$, and gives point F; 270° is $\frac{4l}{3\pi}$, and gives G; 315° is $\frac{8l}{7\pi}$. and gives H. Lastly, when it has reached I it will have completed the circle whose diameter will be $\frac{l}{\pi}$. We have now traced eight points in the curve, and by similar calculation any number of intermediate points may be found. Join these points and the curve will be drawn as shown by the dotted line, A B C D E, &c. Of course, long before the point A had reached I, the metals would have melted, but that does not interfere with the argument.

Fig. 2



Now let us apply this to the compensation balance. I N, Fig. 2, is the diameter through the arms of the balance, and I C H the compound rim of 160° fixed to the arm at I. It will be perceived that every point in this rim is describing some part of the dotted curve of Fig. 1. B, at 45° from the fixed point I, is travelling in the same direction as B in Fig. 1, represented by the line Bb. For if a tangent to the curve at the point B, Fig. 1, be drawn to meet the line I L, it will cut it at the same angle as Bb, Fig. 2, cuts the line I N produced. Similarly at 90°, C, like C in Fig. 1 is approaching in the direction Cc; D, at 135°, like D in Fig. 1, moves in the line Dd; and H, at 160°, in the line Hh. So it will readily be seen that no two points in the rim are moving in the same direction.

But it is not so much with the rim as the weights that we have to do.—Let IN,

Fig. 3

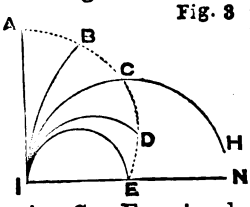
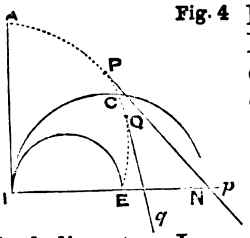


Fig 3, be the diameter of the balance as before, and I C H the compound rim. Let the weight be at 90° from I at the point C. For simple calculation let the diameter of the balance be one inch; then the arc I C=·7854; A I will of course be the same length, wherein the rim is opened out straight. The diameter of semicircle I E $=\frac{2l}{\pi}$=·5; the diameter I B arc of 45°=4 diameter of I E=2, and diameter of I D arc of 135°=$\frac{\text{diameter of I B}}{3}$=·666, draw the curve A B C D E. On examining this diagram it will be observed that if the weight be fixed at 90° from I, the curve passes through the centre of the balance, the weight approaching to or receding from that centre in a geometrical ratio; for if tangents to the curve be drawn to meet the line I N produced, it will be seen that they diminish in a geometrical ratio from infinity at A until they pass through the centre at E. If the weight be fixed at a greater distance from I than 90°, the curve will pass through the diameter of the balance nearer to N.

Fig. 4



For take it at 100°, Fig 4, then the diameter of semicircle I E will be ·555; and similarly at 80° the diameter would be ·444, both to a balance of one inch diameter. In practice we have only to do with the curve about the point C, and this curve would be so slightly modified by the longitudinal expansion and contraction of the steel lamina, that it may be omitted in the calculation. Mr. Hartnup has recommended that the weights should approach the centre of the balance in an increasing ratio for heat, and recede from it in a decreasing ratio for cold. It will be seen by the above that the compound balance already fulfils these conditions; for take two points, P Q, Fig. 4, at equal distances in the curve from C, and draw

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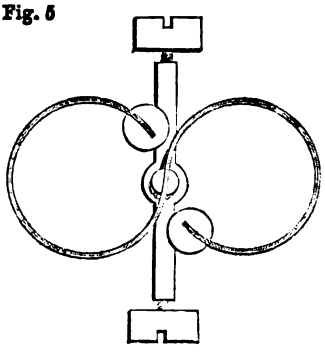
tangents to the curve from those points to meet the line I N, and it will be observed that in the cold it is travelling in the line Pp, and in the heat Qq.

One inference from the above may not be unworthy of notice. It will be seen in Fig. 3 that the nearer the curve is to the centre of the balance, the more directly it approaches that centre. Also in Fig. 1, that the part between H and I approaches I in nearly a direct line. Now, if we transfer this part of the curve to the centre of the balance, we shall be taking advantage of the most effective action of the compound bar.

Fig. 5 shows a balance of this kind.

Fig. 5



The compound bars are longer than in the ordinary balance. Two compound circles, as large as space will allow, are fixed in the centre of the balance, a portion of each being cut away, sufficient only to prevent the weights approaching too near the centre of the balance in extremes of heat. The weights must be placed at the end of the rims, and it will be observed that they approach almost directly to the centre. In adjusting a balance of this kind, the weights must never be moved, but if over-compensated be reduced, and if under-compensated be increased in size. This balance is very simple in construction. At any rate it appears worth a trial. Of course no mortal horologist could write on this subject without suggesting some new modification of the compensation balance!

I am, Sir,

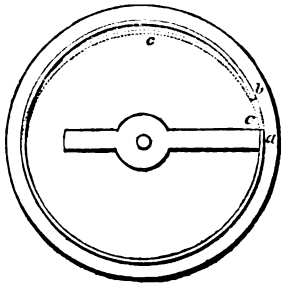
Your obedient Servant,

R. WEBSTER.

74, *Cornhill.*

[THE correctness of this theoretical demonstration of the curve, which the laminated bar of the compensation balance would take, when subjected to heat, is completely proved by a simple experiment. We took an ordinary 2-day chronometer, balance size, 1¼ inch diameter, without weights. Severing the arm as shewn in the engraving, and cutting out 3/16ths of an inch of the extremity of the rim, A B, placed it on a block of brass by a pin firmly fitting the centre hole.

Having previously described a circle, corresponding with the outside circumference of the balance, upon the piece of brass, the balance was exposed; a heat sufficient to slightly colour the steel, by which time the two extremities of the rim were in close contact, the free end of the rim having moved in the direction of the ellipse shewn by the dotted line in the diagram, thus approaching what is the centre of the suggested balance, in a line nearly direct to its centre. The compensating properties of this proposed balance would have to be proved by experiment, but we cannot help thinking that the extremely slight effect of these weights, placed so near the centre, has been overlooked; for as compensation is effected by an influence over the inertia of the *whole* balance, the point where the action of a given weight upon its velocity would be most effective, is that which is at the greatest distance from its centre, and while, if the weight were placed directly over the pivots, or at the centre, its effect upon the balance would be at its minimum.—*Ed.*]



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ON TIME AND TIME-GUNS.

The report of the Astronomer-Royal for Scotland, lately read before the Board of Visitors of the Carlton Hill Observatory, calls attention to a subject of great and growing interest which, for some reason or another, is rather strangely overlooked by us Southrons. We allude to the question of correct time-keeping. It, indeed, is more than strange that in this London of ours especially—where, above all other places in the world, time is money—the true time is scarcely to be had.

It has been well said that we can arrest the flow of time by continued motion, and, by journeying faster than light, actually travel into the past again. The London clocks, however, lessen the difficulty of this feat, for the time once gone—the old proverb notwithstanding—oft returns, and is repeated by lying tongues from a hundred steeples, in spite of the warning tone of Big Ben, which, on the Astronomer-Royal's authority, we can point out as a brilliant exception; albeit one arrived at by much labour, seeing that an attendant receives a signal from Greenwich once *every hour*, and the clock reports its state to Greenwich twice every day.

The eminent men in charge of our national observatories are as ready and willing to "lay on" time to our towns as they are to our coasts. Thanks to their labours, the noble problem of finding the longitude at sea has now been solved with a perfection which leaves nothing to be desired. It is possible now to calculate the place of the moon, for years to come, with a precision which shall surpass that with which a single instrumental observation can be made of it. So that, in fact, unless we improve our time-keeping on shore, the mariners will be ahead of us.

We have before alluded to the magnificent conception which is now being carried out in Paris. So far back as 1852, M. Paul Garnier suggested the establishment of a normal clock, electrically connected with others, which the current should drive and regulate. At the present moment M. Verité, who has reduced the question of electrical regulation to one of great simplicity, is applying it to all Paris. A transit instrument is to be erected in the Tour St. Jacques, where meridional observations will be made and the normal clock installed. Four dials on this noble tower, *furnished with seconds-hands*, will show the time, which electrical currents will give to seventeen other principal clocks, similarly furnished—these in their turn regulating all the other public clocks of Paris. So much for correct time-keeping *à la Française*. In our account of the British Association we described the method adopted in Scotland, and many who have not yet crossed the Tweed had ocular and audible demonstration of it at the meeting at Newcastle, when at one o'clock the true time was proclaimed by cannon from the commanding top of the fine old Border Castle, in its turn o'ertopped by the world-renowned "High Level."

Professor Smyth, in his report, tells of the extension now being given to this eminently practical system. Since the Newcastle meeting, when it was in operation both there and at Shields, and was fully appreciated both by seamen and landsmen, Sunderland has applied, and has now its permanent time-gun. Several other cities have followed suit, and the local negociations for the means of loading their respective guns are in different states of forwardness, the only one which has at present succeeded in perfecting its arrangements being Glasgow, the Queen of the West. Professor Smyth writes:—

"The Edinburgh Observatory dropped a model time-ball daily for a week, by electric means, in a public meeting-room of the Glasgow College in the year 1855. That work was successfully performed, besides its principle having been formally approved; but somehow there was not enough in this time-ball system itself to fully interest the practical inhabitants of the great western city. When, however, after eight years had elapsed, and the inventions of Professor Wheatstone had enabled an electric current to explode a distant gun more easily as well as certainly than to drop a ball, and the citizens of Glasgow did locally provide a cannon, and, aided materially by the well-known Magnetic Telegraph Company, did connect it by wire with the Edinburgh Observatory; and when the current from there did consequently discharge the Glasgow gun simultaneously with the several

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guns of Edinburgh, Newcastle, and Shields, the strong common sense of Glasgow's citizens immediately perceived the superior efficiency of the new system; for, after a week's experiment with from 2 lbs. to 2·5 lbs. of gunpowder a day, from a cannon temporarily placed, as will be seen in a schedule recently received from them, they are now vigorously adopting a new and more suitable locality, with the noble charge of 8 lbs. of powder, or nearly double of what is used at any of the other stations."

In our number for the 24th of January last we gave an extract from the *Scottish Society of Arts*, showing that the Edinburgh time-gun is actually regulating the clocks within a radius of some sixteen miles. Of what incalculable advantage must this be both to employer and employed! Why are we not as well off in London as they are in Scotland? or, indeed, in Liverpool, where, thanks to Mr. Hartnup, who prefers the Parisian system, there are many controlled clocks, and where, it would seem, there is such a superabundance of the true time, that Mr. Hartnup has volunteered time signals to London—to our shame be it spoken! Let us, *en passant*, mention that, on the 4th of February, 1861, between six a.m. and five p.m., one thousand eight hundred and sixty persons compared their watches or chronometers with one of Mr. Hartnup's controlled clocks.

Greenwich is by no means behindhand in fostering this good work; but at present London is slow to appreciate its value. From the Royal Observatory time-signals are sent daily along the principal lines of railway, even as far as Glasgow and Cardiff, and *many private companies, through whose offices the wires pass, have begun to distribute branch signals to private factories.* At the camp at Aldershot, where, we believe, one of these signals is received, a time-gun has lately been in operation, although it is fired by something less ethereal than electricity.

It is a thousand pities that the Westminster clock, which we learn on such excellent authority keeps true time, has its value so seriously impaired by the absence of a seconds-hand. It may be urged that there are many clocks in London so furnished. True, but we pity the luckless wight who shall put his faith in them. We have known many instances where a journey to Greenwich has actually been performed when time true to a second has been required; for we regret to say that the Harrison clock of the Astronomical Society, which ought to show true time, and did a little time ago, has left off doing its duty. The Astronomical Society has, in this matter, lost an opportunity of doing good work.

Let us conclude by expressing a hope that either Professor Smyth's or M. Verité's method may soon be introduced where certainly it is most wanted; let us not be content in this metropolis to be behind Paris, or even our own provincial towns and private factories. M. Verité's arrangement commends itself at once to all. The following extract from the last published volume of the Edinburgh *Astronomical Observations* will show us the great practical value of the former method. A combination of both of them would best suit London.

Professor Smyth, after referring to the time-gun system, remarks:—

"Thus much, then, for the *idea*, and next, on the experience of nearly twelve successive months, we can add that the *practice* of this audible signal has answered to admiration in almost every point. For instance—1st. It has never given wrong time yet, by any accidental discharge before or after the intended time, even to a fraction of a second. 2ndly. It is so remarkably prompt in its action that there is absolutely, and to the most refined observation, no sensible retardation between the striking of the tick of the sixtieth second by the normal clock in the Observatory and the visible gun-fire at the Castle. This result, which is superior to that which occurs with the time-ball by about 0·14 of a second, the amount of constant retardation observed there, is produced by a peculiar compensating action in the controlled clock at the Castle, whereby the trigger of the gun is pulled at such a fraction of a second before one o'clock, that the explosion takes place exactly at one. 3rdly. No inclemency of weather, as rain, frost, or snow, or wind of any strength and from any direction, has ever interfered with the regularity of the gun-fire; and this speaks well, not only for the manner in which electricity is employed to do the work required of it between the Castle and Observatory, but also for the soldiers at the Castle told off to the duty of daily loading the gun, and often having to perform it under circumstances of such extreme wet and discomfort that, unless they exercised much care and skill, the igniting quality of the powder might easily be affected. In fact, since the 7th of June last year, there is only one proved weak point in the whole arrangement; and that is, the quality of the friction fuses, which are prepared by, and furnished from, the Royal Arsenal at

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Woolwich; for one bad fuse—that is, one which does not go off at all, and therefore causes no gun-signal to be heard that day—is still occasionally met with amongst a large number of good ones."

Let us hope that before very long the maps of London shall contain those red concentric circles which already distinguish those of Edinburgh, Newcastle, and Glasgow.

Reprinted from the "*Telegraphic Journal*," of 16th January.

INSTRUMENTS NOT GENERALLY KNOWN.

Earthquake Alarum.—The alarum used in Japan to give warning of earthquakes, consists of a large magnet fixed horizontally across a support which rests on the earth. Attached, by attraction only, to the magnet, is an iron half-hook or claw, whence a silk cord depends that is wound on a revolving wheel, of which the axle works, or rests, in the upright stand (or support of the magnet). To and round the axle there is another cord, holding up a circular (bell metal) clapper, below which is a gong.

The rationale of this arrangement, as explained to Lieut. R. O'B. Fitz Roy by the Japanese Ambassadors (through their interpreter on board H.M.S. Odin, when *quite at leisure* during their voyage), was this:—"Before an earthquake, the ground being full of electricity, the attraction of the (bowl shaped) gong becomes greater than that of the magnet, the claw falls off, and the clapper strikes the gong with a loud reverberating sound, audible at a considerable distance, and warning all to fly into open places."

Now, without attaching undue weight to this very curious, rare, and ancient Japanese invention—said to be many, many centuries old—used only by the most scientifically learned men, and not even known to exist by the great majority of their countrymen, let us examine the Japanese explanation before offering another.

Direct reference to *electricity*—not to magnetic action (about which those very well-informed, able, and penetrating gentlemen of Japan were *closely* questioned)—and *their* references to lightning, with its action on magnetized iron in compasses, showed an intelligence of the subject worthy of those with whom (it has been said) the steering compass originated, (taking them and the Chinese as one people—in *ancient knowledge*).

In contradistinction to the Japanese view, it has been urged by high authority, that trembling or vibration of the ground may shake off the claw before it is sensible to inmates of a house, and that a simple mechanical effect may be thus produced, entirely independent of electricity or magnetism. But to those who have been accustomed to earthquakes by long residence in the countries afflicted by them, this suggested explanation appears insufficient. So delicately sensititive does the human nervous system become, after *experiencing* earthquake convulsions, that the very faintest tremor, insufficient to ring a bell, or ruffle liquid in an open vessel, is felt by human organization.

Were these alarums used only at night, during hours of sleep, such an explanation might have more weight; but, since it was first kindly offered, further inquiries have been made, from which it appears that the instrument is as useful by day as by night, and that *ordinary* vibration or tremor of the ground, such as carts or horses, or other passing weights cause, does *not* affect it in the least.

Lightning Averter.—In Japan, China, Cochin China, Siam, Burmah, Ceylon, and other eastern countries, a system has prevailed, from time immemorial, of placing lumps of glass, either shapely or irregularly massive, on the pinnacles or other highest points of buildings, to *avert* lightning.

About the beginning of this century, the Japanese added to some of their *Averters*, European Conductors, and now have buildings supposed to be thus *doubly protected.*

Some of the British lighthouses had similar *Averters*, even in this century—doubtless suggested originally by captains of East Indiamen.—*From "The Weather Book," by Admiral Fitz Roy, F.R.S., M.I.F.*

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British Horological Institute.

PRIZE FUND.

DETACHED LEVER ESCAPEMENT.

Agreeably to the plan sketched out in the last year's report, the Council are enabled to announce that the following programme is submitted to the members of the trade.

A Prize of Thirty Guineas will be given for the best "Treatise on the Detached Lever Escapement and its varieties." To fulfil the object of the prize donors, it is desirable that the treatise should embrace the history of the various improvements in the Lever Escapement to the present time, pointing out the advantages said to be obtained by each, together with practical directions for securing the action sought by the inventor. It should also treat of the subject generally, giving tables of proportions of the various parts for the ordinary constructions, and explaining the effects of variations in these proportions. It is also extremely desirable that the procedure followed by an expert escapement-maker, in making a first-class escapement, should be clearly described. To make the essay still more practically useful, it should notify to the examiner the points to be especially tested, and the best means of rectifying any discovered error.

Various tools for effecting the several measurements and for facilitating the completion of the escapement, should also be described. The text would be more readily understood if illustrated by simple diagrams.

The competing essays must be delivered in, on or before the 3rd September, 1864, under cover to the undersigned at the Institute. Each treatise must be marked with some device or motto, and should be accompanied by two envelopes, one superscribed by some motto, and containing the name and address of the writer, only to be opened if the essay is successful. The other envelope to be addressed to Mr. Klaftenberger at the Institute to contain the name of a gentlemen proposed as one of the judges.

There will be three judges: two of whom have been nominated by a majority of the subscribers at a meeting of that body, viz.: W. Hislop, Esq., F.R.A.S.; and A. Walsh, Esq., M.I.C.E.; and the other one is to be nominated by the authors of the essays as above. Should no one be nominated by the authors, or should there be an equality of votes, or should the person refuse to act, the election will be determined by a majority of the subscribers.

The judges will have the power of awarding a less amount, should none of the essays be considered worthy of the Prize offered.

The judges will be requested to give their decision in not more than one month from receiving the essays for award.

The writer of the essay to whom the Prize shall be awarded, shall be entitled to the copyright, the subscribers reserving the right of publishing it in the Journal, in whole or in part, as they may think fit, but not till six months have expired after adjudication of the Prize, and payment of the amount of award.

As the present announcement is but the opening of a plan for encouraging the publication of knowledge connected with the art, and for promoting improvement in the manufacture, the assistance of members of the trade by subscriptions is requested. Intending subscribers are requested to forward their names or subscriptions to the Honorary Secretary of the Prize Fund, at the Institute, or through any subscriber to the Fund.

Subscriptions will be acknowledged periodically in the Horological Journal, the pages of which are open to communications on the subject.

J. JONES, *Chairman of Committee of Prize Fund.*

R. STRACHAN, *Hon. Sec. to the Committee.*

N.B.—The above complete Notice issued by the Prize Fund Subscribers' Committee is published to furnish intending competitors with full and detailed information as to the conditions for this Prize, and we trust will meet with attention from Members and Horologists generally. ED. H.J.

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	£32	2	6

BRITISH HOROLOGICAL INSTITUTE—ANNUAL DINNER.

The Annual Dinner of the Institute was held at St. James's Hall, Piccadilly, on Tuesday, the 23rd ult. The Hon. Major Fitzmaurice presided, in the absence of the Earl of Orkney, who was, by reason of serious indisposition, unable to take the chair.

Among those present were Valentine Knight, Esq., President; Messrs. Klaftenberger, Jones, and Johnson, Vice Presidents of the Institute; Messrs. E. J. Thompson, Blackie, Hislop, S. Jackson, Storer, Kullberg, Mercer, Warman, C. B. Holliday, Mylne, Bickly, Dempster, Straiton, M. Thompson, Strachan, Lange, Johannsen, Mc Donnell, Turvey, Greig, Axmann, Merrill, Bailey, Kirk, Partridge, Bailey, Thickbroom, Ganney, and Browning, and other gentlemen.

The following donations were announced in the course of the evening.

	£	s.	d.
The Hon. Major Fitzmaurice	5	5	0
Valentine Knight, Esq.	10	10	0
C. J. Klaftenberger, Esq.	5	5	0
E. D. Johnson, Esq.	5	5	0
John Jones, Esq.	5	0	0
S. Jackson, Esq.	3	3	0
E. J. Thompson, Esq.	2	2	0
Geo. Blackie, Esq.	1	1	0
D. McDonnell, Esq.	1	1	0
Mr. A. Johannsen	1	1	0
„ Christian Lange	1	1	0
„ V. Kullberg	1	1	0
Mr. D. Glasgow	1	1	0
„ G. E. Mylne	1	1	0
„ Macdonald & Co.	1	1	0
„ John Kirk	1	1	0
„ W. Dempster	1	1	0
„ F. R. Warman	1	1	0
„ Thomas Mercer	1	1	0
„ T. Reynolds	1	1	0
„ Jno. Wycherley	1	1	0
„ R. Webster	1	1	0
„ J. Turvey	0	10	6
„ R. R. Greig	0	10	6
„ Jno. Freeman	0	10	6
„ M. Rinecker	0	10	6
„ E. Klaftenberger	0	10	6
„ Thomas Sachs	0	10	6
„ F. Lecluse	0	10	6
„ O. Axmann	0	10	6
„ F. Browning	0	10	6
„ A. Thickbroom	0	10	6
„ C. B. Holliday	0	10	6
„ E. Storer	0	10	6
„ Alexander Straiton	0	10	6
„ Dunbeyr	0	10	0
„ J. Austen	0	10	0
„ Sitch	0	10	0
„ J. Brough	0	5	0
„ R. E. Robinson	0	5	0
„ H. Ganney	0	5	0
„ G. W. Abbott	0	5	0
„ Hooksseller	0	5	0
„ J. Wood	0	5	0
„ James Bailey	0	5	0
„ William Bailey	0	5	0
„ W. Neville	0	5	0
„ H. Bickley	0	5	0
„ J. Partridge	0	5	0
	£63	6	6

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., JANUARY, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F., and mean sea level	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9 A.M.	During the next 24 hours
	inches.	o	o	o	o				
1	29·912	34	32	40	34	NE	4	o	b, os
2	30·502	30	28	35	25	ENE	2	om	o, b, s
3	·628	31	31	34	25	E	3	o	mbc
4	·600	24	—	33	22	ENE	2	cb	c, m
5	·414	29	—	31	22	ENE	2	om	bc, f
6	·280	18	—	31	17	NE	5	bc	f, b
7	·270	21	—	25	17	Calm	0	bm	ff, m
8	·085	27	—	30	19·5	NNE	1	cm	ff
9	29·954	30	—	31	21	NE	2	m	m
10	30·010	34	33	36	29	SSW	1	m	f
11	·180	34	32	39	32	NE	1	c	m, b, o
12	·125	37	36	39	32	E	2	om	om, rr
13	·364	37·5	37	39	35	SE	1	r	rm
14	·340	37	36	38	35·5	E	1	rm	mm
15	·523	33	32	39	31	SSE	2	m	mm
16	·328	37	35	38	32	SE	3	o	m, b, r
17	·027	35	34	38	31	S	3	r	r, m
18	·113	40	39·5	40	35	SE	1	mm	m
19	·224	43·5	42	45	39	S	2	om	cb, rr
20	·311	45	44·5	47	42	SW	6	r	o, mr
21	29·992	48	47	48	44·5	SW	4	o	o
22	·851	50	48	50	43	SW	6	o	o, qr
23	·795	52	49	53	49	SW	2	c	o, rr
24	30·180	38	37	52	36	WNW	4	b	b
25	·454	39	37·5	44	34	W	1	om	o, bm
26	·330	41	38	44	37	SW	2	mb	cb, r
27	·022	47·5	46	47·5	38·5	SW	5	o	cb
28	29·962	42	40	51	39·5	W	6	bc	bc, r, b
29	30·398	36	33	48	35	NE	3	b	bc
30	·525	35	33	39	26	SW	2	o	bc
31	·395	33	31	38	28·5	SW	3	m	bc
	30·235	36·1	—	40·1	31·9		2·6	Mean.	

REMARKS.

The maximum height of the barometer was 30·63 about 9 a.m., 3rd; the minimum, 29·74 at 8 a.m., 23rd.; hence the range was 0·89 of an inch.

Rain fell on 11 days, during about 80 hours and only 1·09 inch was collected.

According to the table it appears that the wind blew from N. on 4 days; E., 10; S., 9; W., 7; and 1 day was calm.

Frost formed on 18 nights at least.

There was a S.wly. gale from 8 p.m., 22nd.; till about 5 a.m. next morning.

J. T. E. is recommended to obtain the List of Patents published under the head of Clocks and Watches, to be had from the Great Seal Patent Office, 25, Southampton Buildings, W.C., sold there for one shilling. There are keyless mechanisms, acting by means of one pinion, and one wheel in use.

EQUATION OF TIME TABLE.

For March, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *added* to Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Tues . .	1	12 28.88	0.508	12 28.99
Wed . .	2	12 16.46	0.527	12 16.57
Thurs .	3	12 3.60	0.545	12 3.70
Fri . . .	4	11 50.28	0.564	11 50.39
Sat . . .	5	11 36.53	0.581	11 36.64
Sun . .	6	11 22.39	0.598	11 22.49
Mon . .	7	11 7.83	0.615	11 7.94
Tues . .	8	10 52.89	0.630	10 53.00
Wed . .	9	10 37.59	0.645	10 37.70
Thur . .	10	10 21.94	0.660	10 22.05
Fri . . .	11	10 5.94	0.673	10 6.05
Sat . . .	12	9 49.65	0.686	9 49.75
Sun. . .	13	9 33.04	0.698	9 33.15
Mon . .	14	9 16.15	0.709	9 16.26
Tues . .	15	8 59.02	0.719	8 59.12
Wed . .	16	8 41.63	0.729	8 41.74
Thurs .	17	8 24.04	0.738	8 24.14
Fri . . .	18	8 6.24	0.745	8 6.34
Sat . . .	19	7 48.26	0.752	7 48.36
Sun . .	20	7 30.12	0.758	7 30.22
Mon . .	21	7 11.86	0.763	7 11.96
Tues . .	22	6 53.49	0.767	6 53.58
Wed . .	23	6 35.05	0.770	6 35.13
Thurs .	24	6 16.53	0.772	6 16.61
Fri . . .	25	5 57.96	0.773	5 58.04
Sat . . .	26	5 39.41	0.773	5 39.48
Sun . .	27	5 20.86	0.772	5 20.93
Mon . .	28	5 2.34	0.770	5 2.41
Tues . .	29	4 43.88	0.767	4 43.94
Wed . .	30	4 25.51	0.763	4 25.56
Thurs .	31	4 7.23	0.759	4 7.28

NOTICE TO MEMBERS AND FRIENDS.

The Council of the Horological Institute have much pleasure in announcing that the Portrait of the late THOMAS EARNSHAW has been added to their Collection, and now adorns the walls of the Reading Room.

They beg further to bear testimony to the admirable manner in which *Mr. Bellin* has copied, on steel, the original Portrait by Sir M. A. Shee. Of this the Members and their friends may judge by an inspection, to which the Council hereby invite all.

Proof Impressions may be obtained only by applications at the Office of the Institute, price 10s. 6d.

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The Journal may also be had at the following Watch Tool Warehouses:—Delolme's, Rathbone-place; Ehnhuus, 54, Frith-street, Soho-square; Grimshaw, 35, Goswell-street; E. Hunt, Ironmonger-row; Lowther, Red Lion-street; Muller, King-street, Soho; E. J. Thompson, 5 & 6, Arcival-street; Williamson, Frederick-place; Haswell, Spencer-street; C. B. Johnson, Market-place, Prescot, Lancashire; Stevens, Goswell-road; Margetts, "P.O," Goswell-street; and of all Booksellers in Town and Country.

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COMPENSATED PENDULUMS FOR GRAVITY ESCAPEMENTS.

Sir: I have now had time to test, by experience, a discovery I made about two years ago of a very remarkable mistake in the hitherto received calculation of the height of the mercury required to compensate a seconds pendulum of the usual construction, and especially those with a cast-iron jar.

It was originally given by the late Mr. F. Bailey, P. R. Astr. Soc., in the first volume of that Society's Memoirs; and the calculation there is so long and complicated, that it is not surprising that his statement of the ultimate result has been accepted in faith by other writers. Certainly I should never have thought of wading through it if I had not found that some calculations of my own for a new pendulum to carry 28 lbs. of mercury obstinately refused to conform to Mr. Bailey's within a difference of 2in. in the height of the mercury.

The error is nothing less than this:—After taking into account a number of small and comparatively insignificant elements, he altogether forgot the weight of the jar itself, which is not inconsiderable, even if it is a glass one with the usual frame or stirrup; and if it is iron (which, for various reasons, is the best construction), it is never less than one-third of the weight of mercury even in a wide jar, and more in the usual 2 in. jars. And as the rise of the top of the mercury has to compensate not only for the fall of its bottom, when the rod expands by heat, but for the fall of the heavy jar also, it is evident that the height of the mercury must be considerably more than if the weight of the jar might be disregarded. Exactly the same mistake was made by Captain Kater in his popular version of Bailey's calculation in Lardner's "Mechanics." In the "Rudimentary Treatise on Clocks," I gave no calculation of my own, but merely stated the generally received result, with a small addition which seemed to be suggested by experience.

But practical men will reasonably ask, how such an error as that has escaped revealing itself long ago by astronomical clocks going visibly slower in hot weather than in cold? One answer is, that it has revealed itself, to some extent, to careful observers. Old Mr. Dent had gradually increased the height of the mercury in his pendulums from the usual 6½ to 7 in., though he was no more aware than I was then of the true reason why it was required. But the more complete answer is, that (as I have intimated in the "Rudimentary Treatise") there is a natural tendency in dead escapements, which nearly all astronomical clocks have, to go slower in cold weather from the greater friction on the pallets; and this, to some uncertain and variable extent, makes up for the deficient compensation of the pendulum. I find, too, that Hardy, the inventor of the first gravity escapement which really answered at all, calculated his compensation for himself, and calculated it (as far as I can judge from the result) rightly, making the mercury full ½ in. more than Bailey for a glass jar; and there are recorded rates of some of Hardy's clocks which can surpass any that I have seen of dead escapements with mercurial pendulums; although from the extreme delicacy of construction and management which it required, his escapement has been abandoned.

My own clock, with the four-legged gravity escapement, described in the "Rudimentary Treatise," p. 137, 4th edition, and a pendulum with 8⅓ in. of mercury in an iron jar, went all last winter, and until it was disturbed late in the summer, without any variation whatever, that I could observe, from the Westminster clock. And, as that clock records its own rate galvanically at the Greenwich Observatory daily, and the Astronomer Royal reported officially last summer that it "may be considered certain within much less than a second a week," (not a second a day, which was originally required by the Government and pronounced impossible by the London Company of Clockmakers), it necessarily follows, that any other clock which keeps with that, for any length of time, may be considered as going with absolute accuracy. Another

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clock, of the same construction, belonging to a friend of mine who is an astronomer, appears to have gone equally well for a year. I need hardly say that the Westminster pendulum of 6 cwt. is not a mercurial one, but zinc and iron; and that clock, with its cast-iron wheels, and a ton and a quarter of dial work to drive on four dials each of 400 ft. area, owes the wonderful rate described in the Astronomer Royal's report entirely to its gravity escapement, which, in large clocks, is best made in the "double three-legged" form, (see "Rudimentary Treatise," p. 134), though the "four-legs" is better for small ones.

The necessity for this greater height of mercury is far from being a disadvantage; on the contrary, it increases the weight of the pendulum without requiring an inconveniently wide jar; and the heavy jar also gives you a pendulum of given weight with a less quantity of mercury. I find that several astronomers have come to the same conclusion as myself, that the common regulator pendulum of about 5 lbs. altogether is too light; and the late Mr. Bloxam ascertained also that it is more affected by barometrical changes than a heavy one. The proper height of mercury in an iron jar $2\frac{1}{2}$ in. wide inside will weigh 20 lbs., and the jar about 7 lbs. more. A 3 in. jar weighing 10 lbs. will take 28 lbs. of mercury. The jars are cast $\frac{1}{4}$ in. thick, which is reduced a little by turning the outside. The rod and other appendages will generally be nearly a pound more. Some persons have had their jars wider still; but the experience of my clock proves that the last-mentioned size is enough for what may be called perfect accuracy of going.

After what I have said of the complexity of the calculation, I am almost afraid to venture upon the mathematics of the question here. But by availing ourselves of certain known results, and disregarding insignificantly small quantities, it can be exhibited in a sufficiently simple form as follows:—

Let R be the weight of all the pendulum except the mercury; r, the distance of the centre of gravity of this empty pendulum from the top; and h, that of the mercury alone; M being the weight of the mercury, and $2x$ its height in the jar; l, the length of the simple seconds pendulum, to which the actual compound one is to be equivalent. There is another quantity which strictly enters into the calculation, though I shall presently omit it again as too small to affect the result sensibly in a jar no wider than the widest of those above-mentioned, viz.: $2b$ the width of the cylinder of mercury. Then,

$$l = \frac{\frac{R}{M}r^2 + h^2 + \frac{x^2}{3} + \frac{b^2}{4}}{\frac{R}{M}r + h} = \frac{\frac{r^2}{m} + h_2 + \frac{x^2}{3}}{\frac{r}{m} + h} \text{ say.}$$

Strictly speaking, the r of the numerator is not quite the same as the r of the denominator; but as the rod is light compared with the jar, it is better not to complicate the calculation by distinguishing them.

All these lengths become altered by expansion under heat; and as we are only concerned with their proportionate expansions, we may get rid of a good many decimals by saying, that r becomes $1{\cdot}0065\ r$ for 1,000 deg. of heat (for it is not worth while to distinguish the small difference of expansion of the iron jar from that of the steel rod). The corresponding expansion of mercury in bulk as a fluid is ·1; but from this has to be deducted the lateral expansion of the jar in the ratio of $1{\cdot}0065^2$ to 1, in order to get the rise of the mercury, and the result is, that x becomes $1{\cdot}087\ x$, and $\frac{x^2}{3}$ will become $\cdot 394\ x^2$.

The alteration of h is a compound of the variations of both metals, and it will be

$h = 1{\cdot}0065\ (h+x) - 1{\cdot}087\ x = 1{\cdot}0065\ h - {\cdot}08\ x$;

$h^2 = 1{\cdot}013 h^2 + {\cdot}006\, x2 - {\cdot}161\ hx$;

and the new length of the equivalent pendulum,

$$\frac{l}{1} = \frac{1{\cdot}013\ \left(\frac{r^2}{m} + h^2\right) + {\cdot}4x_2 - {\cdot}161\ hx}{1{\cdot}0065\ \left(\frac{r}{m} + h\right) - {\cdot}08\ x}$$

If this is greater than the former l, the compensation is not enough, and *vice versa*. But we may simplify these equations a little more, by substituting definite values for some of the symbols. You may ascertain, by measuring a pendulum

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of this kind which is vibrating seconds, that h, the distance from the top down to the middle of the mercury, differs very little from l, and it may be taken as 40 in. for facility of calculation, and r will be found to be about $=9\ h$. Again, as we must at last take some definite proportion for the weight of the empty pendulum to that of the mercury, we may as well put m, or $\frac{M}{R} = 3$ at once, and that will make the equations.

$$l = \frac{508 + \frac{x^2}{12}}{13} = \frac{514{\cdot}4 + \frac{x^2}{10} - 1{\cdot}61x}{13{\cdot}08 - {\cdot}02\,x} = l$$

Even this is a cubic equation; but fortunately the x^2 term is so small, that it may be disregarded, and the solution of the remaining quadratic equation is $x = 4{\cdot}32$. And, as we took $h = 40$ in. instead of about 39 for facility of calculation, we may say, without any material error, that $2x$, or the proper height of the mercury in such a pendulum, $= 8{\cdot}5$ in., or about one-third more than by Bailey's calculation. If the jar is heavier than one-third of the mercury, its height will have to be increased in the same proportion.

This error of compensation is equivalent to no less than a variation of a second a day for a difference of 40 deg. of temperature. And such an error as this, having hitherto been kept latent by a sort of irregular counteracting error inherent in the variable friction of the dead escapement, proves how far that escapement really is from the perfection which is generally supposed to belong to it, and was even supposed for many years to have been mathematically proved to belong to it; while gravity escapements were also "proved" to be incapable of answering, by Mr. Airy, in a well-known paper in the Cambridge Philosophical Transactions, vol. ii. It is singular that he should have lived into the position of having officially to testify their accomplishment of an accuracy before unknown in horology.

E. B. Denison.

33, Queen Anne-street, Feb. 2, 1864.

A writer in the same Magazine makes the following remarks on the above article:—

COMPENSATING PENDULUMS.

Sir: Perhaps the following remarks in reference to Mr. E. B. Denison's paper "On Compensating Pendulums for Gravity Escapements," may not be unacceptable. Mr. Denison's discovery of the error in the generally received calculation, given by Bailey, for the height of the mercury column in a Graham pendulum will, perhaps, help to convince horologists how unfit the Dead Beat Escapement—so long considered the *ne plus ultra*—is for the highest purposes of timekeeping. I have long held an opinion, founded on my own experience, of the Dead Beat Escapement, as well as on the testimony of others who have carefully studied its performence, that the application of a compensating pendulum to it is of no use whatever. The Horizontal Escapement—the portable form of the dead beat—is never made with a compensating balance, just because, like the dead beat, the dead friction in it has a compensating effect, which, though variable and uncertain in its amount, approximates a true compensation.

I have found Dead Beat Regulators, without compensating pendulums, perform better than others of equal quality of construction, but which had mercurial pendulums, on the adjustment of which the greatest care had been bestowed. This no doubt happened by the natural compensating effect of the escapement in the former being *accidentally* equal to the effect of the changes in the length of the pendulum. In the chronometer and other *detached* escapements, the necessity for a compensation for temperature at once shows itself; and the superiority of these escapements is proven by the exactness with which they can be compensated. The recent improvements in gravity escapements show that the *mechanical* defects which were considered essential, and which so long prevented them from gaining favour, are not such defects as may not be obviated, and they give promise that the gravity escapement shall give the most perfect division of time on the "small scale" that has yet been attained. I am, &c.,

Henry Kerr.

46, High-street, Dundee, Feb. 10, 1864.

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To the Editor of the Horological Journal.

Sir: A letter has appeared in No. 267 of the *Mechanics' Magazine*, on the height of the column of mercury required to compensate an ordinary seconds pendulum. As this is a question of great importance, I conclude that you will probably transfer that letter to your pages, and if you do so, I would beg to be allowed to make a few observations on the subject.

The writer, Mr. Denison, states that he has made the discovery, that there is a great mistake in the formula for the height of the column of mercury in the mercurial pendulum, and attributes to Mr. Bailey an unaccountable error in his calculation, stated to be published in the first volume of the transactions of the Astronomical Society. Without going into the latter questions or attempting to follow through certain mathematical calculations, with which the writer favours us, I would simply, as a practical man, claim for myself and my compeers, the knowledge of the facts, the discovery of which is thus claimed by Mr. Denison. Every one who has rated a mercurial pendulum knows that 7·5 inches or 7·8 inches is not enough, but must be increased, but why? Not because Mr. Bailey's calculation may be wrong, or because the dead beat escapement is so very defective, but because the usual pendulum suspension is a steel spring, for the alteration of which, by temperature, allowance must be made. We have, in fact, to make the centre of oscillation of our pendulum actually rise in heat to compensate for the loss of force or rigidity or elasticity, whichever you please to call it, of the spring by heat.

Strange to say, this most important element in the calculation, namely, the suspension spring, has been altogether neglected by Mr. Denison in his investigation. The same oversight is committed, to a farther extent, by another correspondent, who follows on the same side in the next number of the same Journal. Mr. Kerr condemns the Graham escapement, and to give force and illustration to his meaning, he says, "The Horizontal escapement—the portable form of the dead beat—is never made with a compensating balance, just because like the dead beat, the dead friction in it has a compensating effect." Subsequently, he speaks of the exactness with which certain other *escapements*. "can be compensated." Now, without stopping to point out that the increased angular motion of the horizontal escapement destroys its merits in comparison with the clock dead beat, and that the lever escapement would be a more exact parallel, the argument of Mr. Kerr does not take into account the pendulum or balance spring upon which the great disturbing effect is produced by temperature, and with which we especially have to deal in compensating a chronometer or watch, and partially to deal in compensating a pendulum suspended by a spring.

With respect to the question of the weight of mercury to be used, practical experience, as well as mathematical reasoning, will then show that it must depend upon the mass of the pendulum. The governing power of the counteracting material will of course depend upon its proportion to the rest of the mass. And we shall find, accordingly, that if we add uncompensated weight to a pendulum otherwise accurately adjusted, we must increase the volume of the compensator, increasing its diameter or height. The objection to a high narrow column with an iron jar is simply that it is too sensitive, for the jar passing through a wider arc than the rod of the pendulum, comes more into contact with the particles of the atmosphere, through which heat is communicated, and therefore commences to expand too soon, and if long, to too great an extent, so that the clock will gain before the rod is affected and the balance between the rod and column is re-established.

Mr. Denison is of course to be excused for his partiality to the gravity escapement, but I beg to suggest that its *complication*, by which I mean increased number of moving parts, is a decided mechanical disadvantage; while it is very questionable whether the adhesion or friction between the locking surface of the detent and the locking arms does not produce as much error as the friction on the jewelled pallets of the Graham's dead beat, which he condemns.

In reference to the Westminster Clock, permit me to remark that the extreme

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accuracy attributed to it is scarcely appreciated by the public, as it is not easy to read tenths of a second by a hand of several feet in length, revolving once in an hour at so great a height from the ground. The private manner in which the clock is kept prevents all proper appreciation of its character, and renders it absolutely impossible for practical men to verify the facts.—I am, yours, &c.,

POLARIS.

PROGRESS OF TIME SIGNALS BY ELECTRIC COMMUNICATION.

In the annual report of the Royal Astronomical Society, under the head of "Proceedings of Various Observatories," the following statements are embodied, a perusal of which will doubtless be of interest to our readers.

We trust when the Metropolitan Railway communication is complete, that the facilities the lines themselves afford, the liberality which has always characterized railway directors in matters of scientific import to the public, coupled with the readiness which the Astronomer Royal has always evinced in aiding those who have sought to improve the existing methods of signalling true time for either scientific or manufacturing purposes, will lead to improvement in the practice of transmitting signals and in the receiving instruments, as well as to a large increase of time signals generally. The public spirit of Clerkenwell will be held in little estimation, if when these facilities are complete, there be not at least one public Time Ball for general reference, and for the use of its Chronometer Makers.

Royal Observatory, Greenwich.

The galvanic connections of the Observatory have been still further extended during the past year. Currents from the Observatory now fire time-guns at Newcastle and Shields; and the Westminster Clock sends daily indications to Greenwich, by which its error is always known at Greenwich; currents in the opposite direction being sent from Greenwich, which enable the attendant to adjust the Westminster Clock to accuracy.

Royal Observatory, Edinburgh.

In the department of time-signalling, some important extensions have been made during the past year, almost involuntary on the part of the Observatory, but strictly in accordance with original instructions to the Astronomer Royal for Scotland. Of the three methods which are practised in the Observatory, viz.: by electric-controlled clocks (R. L. Jones's patent), and of which there are now no less than six; electric-dropped time-ball; and electric fired time-gun,—the first and the third seem to be most in public demand. The Edinburgh time-gun, at a distance of 4,000 feet from the Observatory, is fired by a special application of electricity, which, thought apparently the very best that could be contrived for that case, does not suit very much greater distances, as it implies the continued and permanent use of a wire connecting the stations. Hence it occurred to Mr. N. J. Holmes, Telegraphic Engineer, in the course of the last spring, to elaborate a method, based on the use of Professor Wheatstone's magneto-exploder and Mr. Abel's magnetic fuse; and having obtained promise of assistance from the Royal Observatory, Edinburgh, the experiments went rapidly forward. The first point was, to ascertain the trustable amount of exploding power available in this manner along the ordinary open lines of telegraphic wire. Accordingly, with the further help and countenance of the Electric and International Telegraphic Company, a previously arranged series of currents was sent off from the magneto-exploder (in external appearance merely a box of about 8 inches cube) in Edinburgh, to the Company's Office in Newcastle, a distance of 120 miles; and the result in the times and intervals, as tested by a chronometer belonging to Messrs. Reid, of that city, showed no sensible hesitation or hang fire.

This notable experiment settled the great power of Wheatstone's exploder in overcoming the resistance of a very long

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wire when its insulation was good; but when that was bad, as happened only the following day, by reason of a heavy fog, the high intensity of the magnetic currents caused their loss and dissipation before reaching Newcastle. Hence a practical system was soon devised, by which a large signal-sending clock, recently prepared for the Royal Observatory, Edinburgh, by Messrs. Ritchie and Sons, clockmakers there, despatched along the line a current of galvanic electricity of low intensity; and this, on reaching Newcastle, automatically liberated there a current of *magnetic* electricity, which had then only a few hundred yards to travel, through a covered wire, to the place where the time-gun was placed.

Professor Smyth, with the aid of local subscriptions, extended his experiments to other cities in England and Scotland; altogether, no less than seven different "distant" time-gun signals have been successively — though they are not all at the present moment — fired, directly from the Royal Observatory, Edinburgh, and day by day further inquiries are being made from other quarters, and five more cities are already in pretty active preparation; while Government, with a truly liberal discernment, has looked on the system so favourably as to lend guns, 24-pounders, to nearly every city that has fully subscribed among its citizens for the expense of powder and maintenance.

The Royal Observatory, Edinburgh, has been consequently obliged to enlarge its galvanic batteries and telegraphic connections, and has drawn up a set of rules and a system of supervision, including a weekly schedule report, for any distant time-gun, where Edinburgh currents are expected. By strictly insisting on these rules, those cities in connection with the Edinburgh Observatory will have the satisfaction of knowing, that, however distant they may be from Edinburgh, their time-signals are fully as prompt and exact, even to a very small fraction of a second, as if they had a Royal Observatory within a few feet of them.

Liverpool Observatary.

It was stated last year that considerable alterations had been made in the method of giving the errors and rates of chronometers; and, although the docks in the immediate neighbourhood of the Liverpool Observatory, have, for some months past, been closed to sea-going vessels, the increase in the number of ships' chronometers sent to be rated has been considerable. This Mr. Hartnup attributes to the new method of giving the errors and rates being more highly appreciated, during the winter months each chronometer is exposed for a week to the temperatures 50°, 65°, and 80° alternately; and for whatever time the chronometer may be at the Observatory, the error is given at the end of each seven days, together with the mean rate and extreme difference of rate between any two days for each week. The latter, Mr. Hartnup thinks, shows the quality of a chronometer better than any other method that he has been able to devise. The system of clock-controlling, and the method of communicating time to the port generally, as mentioned in former notices, continues to give great satisfaction.

Glasgow Observatory.

Since the installation of the Ochtertyre Equatoreal at the Glasgow Observatory, the attention of Professor Grant has been chiefly occupied with the negotiation of arrangements for the transmission of true time from the Observatory to the City and Port of Glasgow, and the shipping of the Clyde in general. An electric wire has recently been laid down, connecting the Observatory with the University buildings; and two clocks—one the turret-clock of the college, the other a small clock in Professor Thomson's Class-room —have been placed under the control of the mean-time clock of the Observatory, by the application of Jones's well-known method. The result, in both cases, has been completely successful. The Town Council have commenced operations with one of the City clocks, for the purpose of similarly placing it under the control of the Observatory clock; and there is every probability, at present, of Jones's invention acquiring, ere long, an extensive application in Glasgow and the neighbouring towns, in connection with the Observatory of the Glasgow University.

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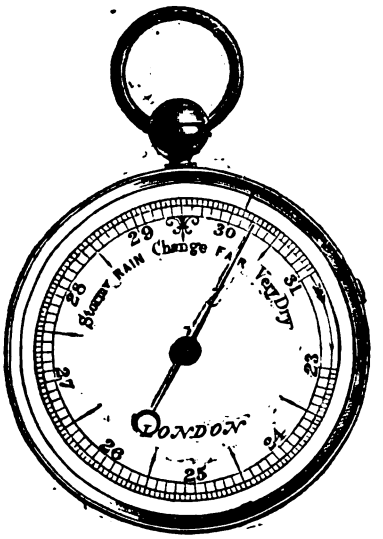
POCKET ANEROID.



The construction of a small barometer of sufficient accuracy, yet diminutive enough to be carried in the pocket, has lately been achieved, adding another to the list of instruments which have found their way into watch cases. Indeed, watch cases are advantageously employed for protecting several pocket instruments, as the conveniency as to shape, size, and mechanism of the envelopes, which almost universally enclose the movements of watches, cannot be disputed. Thus watch cases are used for pocket pedometers, compasses, sun-dials, metallic thermometers, mirrors, portraits, &c.; and are now found convenient and serviceable for aneroids. The engraving is the size of the pocket aneroid as manufactured for Negretti & Zambra, Casella, and other leading opticians; and although thus small, the instrument is in no way inferior to any metallic barometer yet produced.

The aneroid depends for its action on the compressibility by atmospheric pressure of a circular metallic box, from the interior of which the air has been removed, and the flat surfaces of which are held in a state of tension or separation by means of springs. The varying pressure of the air gains or loses on this resistance, and, transferred by suitable mechanism, is indicated by the hand upon the scale. In reducing the size of the aneroid so as to adapt it to watch cases, the greatest difficulty was experienced in constructing a vacuum chamber sufficiently small, yet with sufficient elasticity to expand, and be depressed, according to the lightness and heaviness of the atmosphere. It is satisfactory to the makers, who, after numerous experiments and failures, atlength accomplished their object, that the travelling capabilities of this portable aneroid have been fully tested, and that it has been found perfectly satisfactory for its intended purposes. It is especially adapted for determining heights of hills or mountains, for which it can be employed with as much accuracy as can be attained with any metallic barometer of larger size. Besides, although not an independent instrument, or capable of the same precision as a standard mercurial barometer, it is the best portable means of measuring ordinary variations in atmospheric pressure, and is, therefore, extremely serviceable for foretelling changes in the weather, either on land or at sea.

Could a metallic thermometer, sensitive, accurate, and stable, be combined with the structure of the aneroid, so as to be enclosed in the same case, an instrument of surpassing advantage and service to travellers and tourists would be the result; and the great desirability of such a combination renders it advisable that the makers should earnestly set their minds to accomplish the invention, which, indeed, is merely the surmounting of what has proved hitherto a mechanical difficulty.

R.S.

THE GENEVA WATCHMAKING TRADE.

The *Builder* says that this trade has been much disturbed of late years, and is still depressed. The number of watches made at Geneva has always been over-stated; many of the watches made at Neuchâtel and other parts of Switzerland, where are produced enormous numbers, being attributed to Geneva. In 1858 political events paralysed the trade. In 1851, the Great Exhibition year, it revived, and it is calculated that about 65,000 watches were made in the twelve months—a number which may be taken as the annual of Geneva's best time. In 1860 the number turned out was about 40,000, and in 1861, 10,000 less.

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NOTICES TO MEMBERS.

We again call the Notice of our Readers and of the trade generally, to the admirable Portrait of THOMAS EARNSHAW, Author of the present Chronometer Escapement. It is an engraving on steel by Mr. BELBIN, from the original picture by Sir MARTIN ARCHER SHEE. A framed specimen is on view in the Reading Room, and will afford gratification to all who love to honour and perpetuate the memory of those who have been benefactors to the Science of Practical Horology. As a work of art it is highly spoken of: as a portrait it is one of the most pleasing we ever looked upon—while the price is moderate enough to enable all who wish to do so, to gratify the laudable desire to possess the likeness of one who did so much to build up the fabric of British Chronometry. The price unframed is 10s., or framed £1. 1s.

Application to be made to the Secretary of the Institute.

OBITUARY.

We have to record, with regret, the death of a highly-valued member, Mr. RICHARD ROBERTS, C.E., formerly of the firm of SHARP, ROBERTS and Co., Engineers, Manchester. In the death of Mr. Roberts, mechanical science loses one of the most prolific geniuses of modern times.

He began active life in a stone quarry, and owed his first introduction to practical mechanism to the discernment of a clergyman, who, discovering his natural ingenuity, enabled him to work at a lathe—the patron himself being an amateur Turner. From such small beginnings Mr. Roberts rose through all the grades of practical mechanic engineer and inventor to the achievement of an European reputation.

He was very fond of Horological studies, and followed, with much ardour, that imaginary perfection of watchmaking—the remontoire escapement. The Alpha Clock, exhibited by him in 1851, obtained a medal—it will be remembered by most of our readers.

His Normal Drill for copying and multiplying, in any dimensions, the callipers of the chronometer and watch, is an admirable addition to Horological machinery, and should be better known than it is; and we purpose, as some tribute to his memory, publishing a description and drawing of it at an early date. In the mean time, we may remind our readers, that an original is to be seen at the Gallery of Inventions, South Kensington, and also in the Museum of our Institute.

Mr. Roberts joined the Institute at a very early period of its career, and remained an attached friend to it up to the time of his death.

His remains were interred in Kensal Green Cemetery, the 19th ultimo.

BRITISH HOROLOGICAL INSTITUTE.

The Eighth Anniversary Festival took place at St. James's Hall, Piccadilly, on Tuesday, the 23rd ultimo.

The Hon. Major FITZMAURICE, in the absence of his brother, the Earl of Orkney, took the chair. Among the gentlemen present were Valentine Knight, Esq., J.P., President; E. D. Johnson, F.R.A.S., Mr. John Jones, F.R.G.S., Mr. C. V. Klaftenberger, Vice-Presidents; Mr. E. J. Thompson, Trustee; Mr. Blackie, Treasurer; Mr. Denis McDonnell, Representative for Clerkenwell at the Metropolitan Board; W. Hislop, F.R.A.S., late Hon. Secretary; Messrs. S. Jackson, Strachan, Storer, G. E. Mylne, C. Lange, Eve, Howard, Sachs, Warman, C, B. Holliday, and others.

The vocal arrangements were under the direction of Mr. Fielding, Vicar Choral of St. Paul's Cathedral, assisted by Mr. Seymour, and Mr. Mattocks.

Mr. VALENTINE KNIGHT, rose and said: Gentlemen, I am desirous of making an observation to you before the toasts of the evening commence, with the permission of our excellent friend the chairman. Upon the present occasion we expected to have had the great pleasure and high honour of he presidency of the Right Honourable the Earl of Orkney, one of our members, but unfortunately it has so happened that his lordship has been detained in Paris by a serious indisposition and this severe frost. Our kind friend, Mr. Klaftenberger, who, as we all know, has the interest of of the Horological Institute deeply at heart, had communicated to him the intelligence that his lordship would be unable to be present, and Mr. Klaftenberger, therefore, immediately took upon himself to call on Lady Orkney, and ask her Ladyship's advice under these untoward circumstances. She immediately applied to his lordship's brother, and the result is the presence in the chair of that gentleman—the Hon. Major Fitzmaurice, whom I have now the honour of supporting. It so happened, however, that at the time when Mr. Klaftenberger waited upon Lady Orkney, the honourable gentleman was absent from London, at Manchester, and consequently there was no little difficulty in procuring his attendance upon such a short notice. Lady Orkney, however, with great kindness, telegraphed to him, and he, with the most obliging readiness, acceded to the request made to him, and came up to London to fulfil the engagement entered into by the noble Earl.

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The Chairman then rose and very gracefully proposed the usual loyal toasts, which were received with acclamation. After the National Anthem had been sung, the honourable gentleman proposed the toast of the Army, Navy, and Volunteers, which was suitably responded to by W. Hislop, Esq., Captain, 39th Middlesex.

The Chairman: Gentlemen, I fear you will get tired of me: I have in vain endeavoured to get my honourable friend on my left (Mr. Klaftenberger), or some other gentleman connected with the watch and clock trade, to propose the next toast, but I cannot find any escapement, and I feel as if at a dead lock.

I believe that it is said that there are two things in a man's life he never forgets—the one is his first love, and the other his first cigar: Will you allow me to add a third? I speak feelingly from my own recollections of my pride as a boy, and I daresay many gentlemen can do the same, and that is when I got my first watch. What a grand idea it was to take it to pieces, and how uncommonly difficult it was to put it together again. But it is a very different thing with us at a later period of life; instead of trying then to pull watches to pieces, we take uncommonly great care to keep them together. We give a much higher price for a watch in after life than we did at the beginning. Time becomes of enormous value as we approach its end. I would only ask those who have never thought of the value of a watch or of a chronometer before, to place themselves in the same position, as, I am sorry to say, I have been in, namely, fourteen days and nights in a gale of wind in a ship without a rudder, drifting, God only knows where. When you find yourself, as I have done, in such a position in possession of a chronometer, well-regulated by my excellent friend on the left, you will understand me when I say that I cannot express to you the extreme satisfaction with which I have looked on that little piece of mechanism. When for some eight or ten days you have nothing else to take observations from, it is astonishing with what pleasure you look upon the chronometer. In the present day every description of human ingenuity has been improved through men being educated specially in each particular branch of art. I am not running down general knowledge for one moment, because I believe that a liberal education, and in foreign languages, especially in a commercial country like this, is of the greatest possible advantage to every man in it; still we have peculiar branches of trade and commerce, which are of national importance, such as watch-making and the higher branch of chronometer manufacture. There is not an art which it is of more importance to cultivate in a great maritime country like this. In this land we have Royal Societies extending almost to every branch of education. I think that one great feature in England is this—I do not say that you do not meet with it abroad—that every art and science, as long as it is carried out properly, always meets with the support of the public. That is an interesting fact for everyone to contemplate, because the improvements made in such an instrument as that I have referred to, does no merely benefit the philosopher who uses the chronometer, and makes his calculations by it, but it is valuable to the poorest person in the world in the present day. Connected with this country there are institutions more or less of a benevolent kind, more for the relief of cases of an extremely painful character, such as hospitals, all most excellent of their description; still there is a vast amount of good done by such an Institute as yours, and which ought to be recognized by the public. It is important that there should be brought to bear upon the instrument you manufacture the greatest possible skill. It is perfectly impossible to put a value upon the chronometer when you are exposed to danger at sea, or are required to perform astronomical calculations, without which instrument it would be impossible for them to proceed with the observations necessary for either the one or the other. I believe that no society in the world is more appreciated by the world than your own. There is hardly a respectable person in England, over fifteen years of age, who does not possess a watch; and I think, therefore, that that circumstance must show how your society is appreciated. I certainly did once hear of a father who, when his son applied to him for a watch on the ground that every other boy in the ship had one, said to his son, "For that reason you do not want one." But the boy answered, "I ought to have a watch, if it is only to place me on a level with the other boys." In giving you the toast of "Success to the Horological Institute," I am giving you one which will not only be responded to by every person in this room, but by every man of common sense out of it. I beg to couple the name of Mr. John Jones with it.

The toast was drank with every demonstration of applause.

Mr. Jones: The chairman has already so well recommended the merits of the Horological Institute to your notice, that it is hardly necessary for me to say anything upon the subject. We are much indebted to that gallant gentleman for having left the luxuries belonging to his position to take part in the higher luxuries belonging to our art. It is known, I believe, to the greater part of my auditory, that our intended chairman, the Earl of Orkney, is himself a practical watchmaker. Therefore, the eulogiums which the chairman has passed upon our art this evening, have come from a gentleman who, although not connected with the trade, yet is related to one who takes a practical interest in it, and therefore it entitles all his observations to very great respect. Perhaps a more detailed reference to the operations of the Horological Institute may be expected to come rather from me than from the chairman, in the peculiar circumstances under which he has taken the chair this evening. The Horological is a valuable Institute, because it aims at nothing less than perfection, and that too in an instrument which concerns every man in the world, namely, that he shall have a good measure for that which constitutes the fortune of most persons—the time whereby they get their living. The Horological Institute has done much towards

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bringing about such a result. After a most lengthened reflection upon the matter, I have no hesitation in saying, in view of all that has been done in other arts, that the most perfect of human productions is the chronometer. To produce it, abilities of no common order are required. It is not all of us who have faculties which will enable us to reach so high in the horological art. There are a multitude of sciences which a man must have a competent knowledge of before he can reach that degree of perfection in his art. The honourable and gallant chairman has truly said, that our work is appreciated by the public, but I do not think it is sufficiently so; otherwise it would cease to be a trade, and become a profession in the estimation of the public. Well, gentlemen, what is it we are associated for? That we may distribute among one another the knowledge that we each possess; that those who have climbed the highest may tell others who are still aspiring to reach the same position not all indeed, of the discomforts through which they have passed in the attainment of their excellence, but some of the discoveries which may be made known without injuring their own positions, that general interchange of thought, which belongs to combined bodies, those sciences with which they must be necessarily familiar in their workshops; that those who had attained to the highest position might be thereby enabled to climb still higher towards the goal at which they all aimed —perfection. Gentlemen, we have much to do, socially and commercially, as well as practically, as mechanics, and our Institute may be the means of enabling us to do that which we cannot do single-handed. It might fairly claim from the British manufacturers in other countries, on the part of those able to distribute information, as to the selection of markets in competition with foreign markets, such as might occasionally be given to them. It is not right that we should be compelled to put our light under a bushel, through the circumstance that it was not known that there was such a body as the Horological Institute. I think that its presence towards the West-End to night may do much to introduce us nearer to those who live in those more favoured districts, and who may not previously have known of its existence. It may also do much for our foreign trade, through the medium of our Consular offices in foreign countries, which might put themselves in communication with it, and furnish it with information as to the best markets to send our manufactures to. If you had a good secretary, whose time was devoted to the interests of the Institute, he would be able to communicate with foreign embassies on the subject, and thus place the English maker beyond the reach of any foreign rival in the world. I know that this cannot be done without money, but I hope that the Institute will have no difficulty in raising sufficient for the purpose. Hitherto we have had the voluntary but valuable services of our esteemed honorary secretaries, who, year after year, have devoted themselves to the promotion of our interests (Hear) in the midst of great controversy, much obstruction, and certain pecuniary loss to themselves. But the period has arrived when we must no longer rely upon such voluntary services, valuable though they may be; but we must have a regular *employé* in the office as secretary; a man who will devote himself entirely, without the abstraction of any time in his private affairs, to the carrying out of the ideas which I have enunciated, so that the ramifications of the Institute may be found all over the world, and result in the furnishing of a much larger amount of business in every workshop in Clerkenwell. One object, therefore, of our present gathering, is to urge upon each other the duty of doing something towards carrying out this purpose. The prosperity of the British Horological Institute can only be attained by each watchmaker doing his best to secure it.

The CHAIRMAN:—Gentlemen, the next toast I have to propose to you is "The Healths of the President, Vice-Presidents, and Officers of the British Horological Institute."

I do not know how it is with your Institute, but in all the Associations with which I have been connected, it is the president and officers who have kept the members to their duty. I have long known your respected President by reputation, although this is the first time I have had the pleasure of meeting him. Believe me, gentlemen, the result of my experience of forty years as a soldier is, that the efficiency of the regiment depends mainly on the qualifications of the colonel, and I have no doubt that it is so with your colonel, my honourable friend, if he will permit me to call him so, on my right, your respected President. I have no doubt that he does all in his power to keep your society in its proper position before the world. With regard to the other gentlemen whose names are included in the toast, you know their characters better than myself. I certainly have known Mr. Klaftenberger about forty years. You know perfectly well what they have done for the promotion of the interests of your Institute, and, therefore, without any further remarks, I will submit the toast for your acceptance.

The toast was drank with applause.

Mr. VALENTINE KNIGHT:—Gentlemen, it has been stated that unqualified praise is censure in disguise. My very kind friend in the chair has been pleased to bestow upon me that kind of commendation in referring to my name in connection with the Institute, but I am afraid that it is more entitled to condemnation than praise. ("No, no.") I believe my services have been of no value to it; but at the same time I can venture to assert, that my heart is as deeply interested in the welfare of the Horological Institute, as the heart of any man in this room or out of it. There was one remark of the chairman's from which I differ in toto, and to which Mr. Jones has already replied. The gallant gentleman stated that the Institute was appreciated by every man in the country who wears a watch. With very great respect to him, I beg to deny the fact. That it is appreciated by every man in this room I readily con-

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fess, but not by the public at large. I feel ashamed to say that every man who can afford to put a watch in his pocket, has not done his duty to that watch, which he can never do until he has subscribed to the Horological Institute. It is something like our excellent friend Mr. Fielding, who has just favoured us with a song, his talents are not appreciated as they ought to be by the public, although they are by the gentlemen assembled in this room. It is with great pain I make this remark about the indifference of the public to the Horological Institute. In the absence of the Earl of Orkney, we have been favoured with the presidency of his brother; a fact which I hope augurs much good for the future prosperity of the Institue. I believe we have now travelled further westward than we ever did before. I am very glad to find a member of our aristocracy engaged in the art of watchmaking. I understand that Lord Orkney is well acquainted with the trade of watchmaking. I hope that the merits of the Institute may be known to every member of the aristocracy and the public at large, and that the time may come when, as I have said before, every man who wears a watch will subscribe to this valuable Institution.

Mr. KLAFTENBERGER:—Gentlemen, I rise with very great diffidence, and under much difficulty, to propose the health of our worthy chairman, the Honourable Major Fitzmaurice. I am only sorry that this toast has not been placed in the hands of a gentleman better able to do it justice than I am. Having known the honourable and gallant gentlemen, as he has told you, for forty years, I can assure you that I can bear testimony to the great kindness of his character, as well as to his scientific attainments. You have heard that his brother, the Earl of Orkney, is a great admirer of the watch, and has himself taken much trouble in acquiring a knowledge of its best mode of construction; but I may further inform you, that the gallant chairman himself is not only a soldier, but that for a long time he has been practically a good mechanic, as well as a man of science. For many years he has been endeavouring to make discoveries for the benefit of humanity; and, among others of his inventions, is one which he made a few years ago of an improved reflector, which is used very much in different parts of the country, and especially in the lighthouses on our sea coasts. He has also been engaged in making a discovery which is likely to be of great benefit to our art: and that is a mode of converting iron into steel by a much cheaper process than that by which it has been done hitherto. Having stated these facts to you, I will not attempt to take up your time by a long speech, but simply propose his health. May he live long and be prosperous in his home and his family, and may we have the happiness, upon the next year's anniversary, of seeing him again among us.

The toast was drank with enthusiasm.

The CHAIRMAN: I thank you most heartily for the manner in which you have received my name. I will not accept it merely for myself; but as a kind expression of your feeling towards my brother. My honourable friend on the left, Mr. Klaftenberger, has truly said that I have been acquainted with him for very many years. It is a great pleasure to me always to associate with men of science who have been pursuing one long uniform course, denying themselves many pleasures and amusements, and sticking to one practical point, until they have carried out their purpose. Every man of this description, whatever be the peculiar nature of his occupation, deserves the admiration of the world. From my youth I have been intimately and practically associated with the working men of this country. There is no class in the community whom I more highly admire. I have mixed with the workmen of various countries, but I never yet met with such a patient, persevering body as those in England, although many foreigners may come up to them. I have been intimately acquainted with most of the large concerns in this country. To show you how much one individual can do by perseverance, I will mention one fact. At this moment there is a line of railway in operation, taking £60,000. a year, which was projected by your humble servant. When I first undertook to arrange that matter, there was but one pair-horse coach running over that country. I do not believe that there ever was a nobleman or gentleman who had a greater appreciation of science, or of your art of horology, than the late Prince Consort. I once privately submitted a piece of mechanism to him; it was a very sultry day and my hands were hot. The Prince said, "Sit down, and let me see a diagram of what you are going to do." My hand shook so that I could not draw. He said to me, with the greatest kindness and consideration, "Give me the pencil and tell me what to do." I did so, and he drew it perfectly. I thank you for the honour you have done me. I hope that the young ones, who, I see here, and are now growing up, may carry the horological art to a higher degree of perfection than their fathers have hitherto attained.

The next Toast was "The Watch and Clock Manufacturers of Great Britain."

Mr. E. D. JOHNSON: Mr. Chairman and gentlemen, I beg to return you my most sincere thanks for the honour you have just conferred on me, in connecting my name with the toast of the health of the British manufacturers of Clocks and Watches. I also thank you, Mr. Chairman, most warmly for the eulogistic speech with which you proposed it, and the gentlemen present for the manner in which they received it. I regret that the duty of replying to it has not fallen into more appropriate hands. It is possible that some may say, how could it happen that more appropriate hands could be found than one so identified with the Institute as you have been? I with it had fallen into the hands of some more professional man to reply, and you will, perhaps, feel some surprise when I mention the reason.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., FEBRUARY, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer at 32° F, and mean sea level	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9A.M.	During the next 24 hours
	inches.	°	°	°	°				
1	30·265	35	33·5	40	31	SW	4	m	bc
2	·210	45	44	45	33·5	SW	5	o	omrq
3	·047	48	46	50	45	WSW	2	o	bc,hr,b
4	·168	34	32	50	32	W	3	b	bc, s
5	·284	31	—	41	28	N	3	bc	bc, s
6	·236	31	—	36	29	NNE	3	o	bc, b
7	29·985	27·5	—	34·5	25	N	3	bc	bc, s
8	·800	30	—	32	25	N	2	om	bc
9	·665	25	24	34	23	WNW	2	m	c, b
10	·475	24	22	35	21	N	2	m	f, s, bc
11	·780	34	32	37	22	NNW	2	o	o, rr
12	·500	40	40	40	32	SSW	9	rr	r, o
13	.742	50	49	50	39	SW	8	o	cb
14	30·358	41	40	53	37	SW	3	cb	b, bc
15	29·988	46	45	50	40	SW	3	o	om, r
16	·787	47	46	50	45	WSW	2	r	or, bc
17	·971	37	35	49	33	W	3	cb	c, rs, b
18	30·214	32·5	31	42	30	NNE	2	cb	s, bc
19	·390	29	27	39	28	NE	3	c	ss, bc
20	·090	28	27	33	24	ENE	3	c	s, c
21	29·760	30	29	32	26	NE	3	os	c, s
22	·847	31	30	33	29	NNE	2	os	f, m, b
23	·967	29	28	35	27	NE	1	s	s, b
24	30·010	28·5	27	35	24	NNE	2	c	o, ss
25	·006	35	33	38	28·5	ENE	2	o	o
26	·006	35·5	34	39	33	NE	1	o	omr
27	29·830	37	35	38	35	E	3	o	omr
28	·697	41·5	40	41·5	36	ESE	4	o	omr
29	·653	41·5	40·5	48	39	ESE	1	m	fmr
	29·956	35·3	—	40·7	31·0	—	3	Mean.	

REMARKS.

At 10 a.m., 10th. the atmospheric pressure was 29·461 inches; and at 10 a.m., 19th, 30·395; hence the range of the barometer column was at least 0.933.

Rain or Snow fell on 21 days, during about 65 hours, to the amount of 1·04 inch.

From 11 p.m. 2nd, to 3 a.m. 3rd, there was a s.w. gale, with squalls.

From about midnight, 11th, during the 12th, to about mid-day, 13th, there was stormy weather; wind, s. to w.s.w.; rain measured at 9 a.m., 12th, was 0·26; and at 9 a.m., 13th, 0·14 of an inch.

The wind blew from the N. on 11 days; E., 7; S., 4; and from W, 7.

There were 18 frosty nights.

The temperature has been about 4 degrees below the average; and the weather altogether unusually severe.

EQUATION OF TIME TABLE.

For April, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *added* to Apparent Tim	Difference for One Hour.	At Mean Noon. — Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Fri . . .	1	3 49.07	0.754	3 49.12
Sat . . .	2	3 31.05	0.748	3 31.09
Sun . .	3	3 13.18	0.741	3 13.22
Mon . .	4	2 55.48	0.734	2 55.51
Tues . .	5	2 37.96	0.726	2 37.99
Wed . .	6	2 20.62	0.717	2 20.65
Thur . .	7	2 3.51	0.708	2 3.54
Fri . . .	8	1 46.64	0.698	1 46.66
Sat . . .	9	1 29.99	0.688	1 30.01
Sun. . .	10	1 13.60	0.677	1 13.62
Mon . .	11	0 57.49	0.666	0 57.50
Tues . .	12	0 41.64	0.654	0 41.65
Wed . .	13	0 26.11	0.641	0 26.11
Thurs .	14	0 10.88	0.628	0 10.88
Fri . . .	15	0 4.03	0.614	0 4.03
Sat . . .	16	0 18.59	0.599	0 18.59
Sun . .	17	0 32.78	0.584	0 32.79
Mon . .	18	0 46.62	0.568	0 46.63
Tues . .	19	1 0.06	0.551	1 0.07
Wed . .	20	1 13.08	0.534	1 13.09
Thurs .	21	1 25.70	0.516	1 25.71
Fri . . .	22	1 37.86	0.497	1 37.87
Sat . . .	23	1 49.56	0.478	1 49.57
Sun . .	24	2 0.79	0.458	2 0.81
Mon . .	25	2 11.52	0.437	2 11.54
Tues . .	26	2 21.76	0.416	2 21.78
Wed . .	27	2 31.48	0.394	2 31.50
Thurs .	28	2 40.67	0.372	2 40.69
Fri . . .	29	2 49.32	0.349	2 49.34
Sat . . .	30	2 57.43	0.327	2 57.45

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N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 20th of the month.

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BRITISH HOROLOGICAL INSTITUTE.

(*Concluded from page* 95.)

I think that from a position purely independent as from a "coign of vantage," such non-professional man might have criticized with as much chance of causing amendment as of giving offence. But, Sir, as you have called upon me to perform the task, I accept the honour, with which I claim the privilege, as other men have done, to stick by my order. I will, however, do so not as a partizan, but as one who feels the true solidarity that ought to arise out of similarity of pursuits. I will do so, Sir, in that spirit, without forgetting to tell you why, and giving all credit for their virtues; still, not seeking to screen or avoid the condemnation of their faults. Amongst the broad field of faults and virtues that I have found existing in our body, with your permission, Sir, I will cull only one of each sort. And as it is always more pleasant to dwell upon the virtues than the vices, I ask you to recognise what I will say is our one virtue, which we are undoubtedly entitled to claim the possession of, and that is, the virtue of industry. Let others compliment us for whatever they will, we take this compliment for what it is worth. Now, Sir, I have had long experience of labour in the most rudimentary form, as well as in the highest, and I am prepared to maintain, that although foreign nations may boast of the advantages they have received by the establishment of schools of art and design, and of all the surroundings that enable men, in the absence of all except their own special manufacturers,—I am prepared to say that, let all things be equal, let the surroundings be anything like the same, then for an honest day's work I will back the Briton against the world! Having asked you only to applaud that one virtue, I now ask you only to condemn one vice, because I think from that one vice most of the difficulties connected with our art arise, and that vice is simply a cold unfeeling egotism that induces watchmakers to hide themselves from the world, and to avoid that association of a brotherly character which refuses to recognize other branches of manufacture in this country based upon and containing the same principles. They absent themselves and disassociate themselves from those branches of manufacture. It is enough if they only have a tendency to develop the arts out of which their own arises. I am perhaps in a position to name, at the present moment, a fact not to be discovered by an outsider. To such outsiders this annual dinner would appear a mere social and festive meeting; but this horological gathering has a two-fold significance—material and moral. The material you can see, not the other. We gather together from year to year, and I do not see a single face around this board but what I could suppose might enjoy this special contact, this rubbing together of intellects that is said occasionally to produce sparks of genius. But there is a moral question also in this gathering. It appears to me that this dinner is a means, once a year, of drawing a line of demarcation rather broad between those who follow the profession, and have a soul in them to admire it and to love it, and those who look on the art as a mere engine from which to screw pounds, shillings, and pence. I will not say a word about individuals, I only give you the means of forming a judgment, when I assure you that we have not gathered together, as members of the British Horological Institute, one-tenth part of the whole horological population. So I think I have said quite enough with regard to the demerits of our profession. In spite of all that is said about the decadence of the chronometer manufacture in England, watchmaking, all things considered, was never in better plight. I do not mean to argue from the point that some persons do—that a shopkeeper might choose to establish—namely, from the quantities of goods sold, but I allude to the point generally of foreign appreciation, and of the degree of excellence at which the art has arrived. It is said, you know, that "familiarity breeds contempt." Without asking you to believe so much, I can assure you that the achievement of the modern chronometer, and, what is of far more consequence, the achievements of an ordinary adjusted lever watch, leave far behind all that our forefathers ever dreamed of. Without entertaining you with a parcel of nonsense, or detaining you by any particular instances, I will take the liberty of rectifying one instance of omission by doing what some watchmakers connected with the British Horological Institute ought to do. The poet says that

> "Reproach for benefits received
> Pays every debt and cancels obligation."

But, Sir, I deem it far greater folly for men to forget that they have received special benefit when they get an opportunity of making their gratitude vocal. Such is the obligation we are under to Mr. Hislop, and I therefore take the liberty of travelling out of the regular list of toasts which have been approved by the committee, to propose his health. There is no gentleman present or absent who has done so much for the Institute as Mr. Hislop. (Hear, hear). He has toiled night and day in your service to his own very serious loss.

Mr. Hislop: Mr. Chairman and Gentlemen,—I beg to thank Mr. Johnson for the way in which he has proposed the toast, and you, gentlemen, for having received it so kindly. I trust you will excuse me from saying much on the present occasion, because I am perfectly unable to make myself heard, or to speak with anything like comfort. When I took the office of Honorary Secretary, I did not suppose that I should have been obliged to retire from it. I felt, and still feel, that there is a great work to be done for the promotion of horology, and that if it is not done

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by some association of persons our art will most assuredly decay by degrees. I know that in this country and in France art has has been kept up and science matured by such associations, and I am not foolish enough to imagine that even Englishmen can excel in any science, or promote any object, unless we use the means employed by all mankind. We must do the same thing here in England, if we wish to maintain our manufacture, or increase the popularity of our science. We must gain our object by the same instrumentalities as are used in all other professions. The engineer has an association for the promotion of all the various branches connected with his business. It has been well remarked this evening that the horological art contains many branches of knowledge the development of which requires the associating together of its members. We may help each other, and advance the art of which we are members. I have no doubt that a great deal might be done if we only put our shoulders to the wheel. I have very great pleasure in once more acknowledging the kindness with which you have received the mention of my name. I can only say that in the past I have worked for the good of the Institute, and I shall be happy to do the same in the time to come.

Mr. JACKSON: Mr. Chairman and Gentlemen,—I think we should very ill discharge the duty of this evening if we did not recognise the valuable aid which British watchmaking has received from foreign watchmakers. I regret to say that, personally, I am very little acquainted with the watchmakers of the Continent; but I have the gratification of knowing them in the noblest sense, namely, that of their works. I feel that this toast could have been placed in better hands—in those of persons more cognizant of the personal characteristics of the gentlemen who conduct the watch manufacture abroad. We have the pleasure of the company of some of those gentlemen this evening, and I trust that they will continue to give us that cordial co-operation which we have received from them heretofore, both by their connection with the Institute and by their contributions of models and tools to its museum; and, although that may be somewhat exceptional, even by contributions to the "Journal." We have been told, indeed, even by a representative of French watchmakers of considerable repute, that British watchmaking is "almost a myth," but such a statement is an extravagancy so inflated that a few figures will demolish it, were not our association and our meetings here sufficient to refute such an expression as that. The Continental watchmakers have long been in possession of that superior art-education which we are only beginning to see the fruits of in this country, and the effect of which is apparent in its external application to their beautifully-ornamented pieces of machinery, but which I trust we shall not only equal but very possibly excel in the future; for we are possessing the same advantages as those which they have so long derived benefit from. I hope that the company will receive this toast at least as cordially as they did that of the preceding one, which was virtually the healths of ourselves. Let us show them that we are prepared to accept their friendly rivalry; for such, I trust, is the spirit in which the English watchmakers may always regard their foreign brethren, for since free-trade has become an established fact, and a recognized principle of statesmanship, competition must not only be accepted but welcomed. If there are those among us who fear competition with cheap labour abroad, I would refer them to the characteristic qualities of laborious energy of the British workman spoken to by our chairman this evening, as well as to the results of the great International Exhibition, and they will see that we have not occasion to fear such competition; for if we did not come out gloriously, we, to say the least, were not unsuccessful. We must not only accept competition as an established fact, but do so with the full consciousness that our persevering labour will enable us to take our places side by side, not in enmity, but in friendly rivalry with the nations of the earth. I am sure that you will receive the toast entrusted to me in the spirit in which I have endeavoured to convey it to you, coupled with the name of an esteemed friend of the Institute, Mr. Christopher Lange.

Mr. CHRISTOPHER LANGE: Mr. Chairman and Gentlemen,—On behalf of my countrymen and myself, I beg to thank you for the very flattering manner in which you have received the toast of "The health of the Foreign Watchmakers." It is a subject upon which a good deal might be said, had I known that I should be selected to speak upon it. If I say very little upon it, I hope you will be kind enough to take my will for my deed. The foreign watchmakers occupy in this country, I will not say a disagreeable position in it, for I am afraid that there are some English workmen who look upon us as a body of men who are seeking to take away something rightfully belonging to them. It is by no means my wish to do anything of the kind. We are here to supply a commercial necessity of your nation. Your countrymen, and especially your countrywomen, want certain articles which you might make for them, but which you do not. I do not know why you will not, but you do not; and therefore we are here to supply the want of your community, which you refuse to make. Your countrymen and countrywomen would have no desire to deal with us in preference to the British manufacturers, if they thought proper to make the article which the public require. If you did so, it would be a fair way of driving us away from England; and we should be bound to be quite content to go, having been benefitted by our stay, as we shall be able to take a few thousand dollars away with us. With regard to the Horological Institute, our friends, Mr. Jones and Mr. Johnson have said that about it which leaves me nothing more to add,

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except to recommend you to unite and support it to the utmost of your power. I have worked in a great many countries, because it is our custom to do so, and I have everywhere found that there is nothing so essential to the promotion of the horological art as an interchange of the thoughts and experience of those who are engaged in it. Do not be afraid of your secrets being known. In many cases it is supposed that the success of certain persons is owing to their possession of some secret, but in process of time it has been found out that there never was anything of the kind. I advise you to enlarge your experience by learning foreign languages. I came to this country a stranger, with no name, and possessed of no great abilities; in fact, gentlemen, you knew nothing about me. I wanted work, and got it, and was paid for it very fairly. The same thing has happened to a great many foreigners besides myself. They have come to this country, and been well treated, and have succeeded in establishing themselves; and, therefore, gentlemen, in their names I beg to return you thanks for the toast which you have just received. I could not have received in any country more hospitality than I have experienced in this; and there are a great number of my foreign friends present who are ready to bear the same testimony. Again, I say, let us unite together for the advancement of our common interests. There is a vast number of people to be supplied with watches, although I am sorry to say that there are a great many who have not even pockets to put watches into. Let us unite, and be friends; as I am happy to say we have always been. In conclusion, I again thank you for the kind reception you have given to the foreign watchmakers, a feeling which I hope will always exist between us.

Mr. E. J. THOMSON, trustee of the Institute, having in courteous terms acknowledged the presence of visitors, proposed their health, connecting with it the name of Mr. Sachs; which was responded to by that gentleman.

Mr. VALENTINE KNIGHT having dwelt upon the earnest interest taken by the Treasurer in the affairs of the Institute, and proposed his health, Mr. BLACKIE replied thereto.

The Secretary having read the list of subscriptions and donations,

Mr. JOHN JONES proposed the "Institution of the Press" in some pertinent remarks, in the course of which he said: But notwithstanding all its benefits, there is a great deal of mischief resulting from that Institution. It is causing the people of England to lose a great deal of the individuality which once characterized them. The press has much to do with all our public undertakings. It seems to do the work of thinking for the people. This is a state of things the existence of which I very much lament; it would be far better for people to meet together and consult with one another as to their wants, without allowing the press to dictate to them what to do. When men commence as speakers, they feel highly delighted to see their speeches in print; and certainly, if they really have anything to say, it is very useful to have it published. I beg to couple the toast with the name of Mr. Farmer.

Mr. FARMER: Sir, I have been accustomed to apoligize for brevity in speaking to the toast of "The Press," on account of the lateness of the hour at which it is almost invariably proposed,—at a time when Apollo, and not Mercury, is the favourite god of the company; but the admirable manner in which you have dispatched the business of the evening has deprived me of my customary plea for saying next to nothing. I shall, however, detain you with very few remarks in responding to the toast. Our friend, Mr. Jones, lost his brief, and, so far as I am concerned, I should not have cared if he had not found it again. I am too tired to pick up the gauntlet which he has thrown down. The press was originally called "the fourth estate" by Edmund Burke; but another writer has, I think, with more propriety, designated it a representation of the third estate, on the people. At all events, that ought to be its position in a free country, provided it duly fulfils its vocation as a public teacher, and is not content to run with the multitude, whether the road they take be for good or evil, because that is the best commercial policy. Another writer has been heterodox enough to assert that the true clergy of a country are its journalists. Of course I am not profane enough to endorse such a theory. If they are the true clergy of a country, whatever may be the amount of the gospel they preach, they propagate along with it a large amount of most pernicious heresy. Allow me to express what I have done on many former occasions,—my sincere desire for the prosperity of the Horological Institute. I had the privilege of being present at its birth, and have to the best of my power fostered its growth, and I regret that it has not attained those dimensions which I think its importance ought to have procured it. When trade is prosperous men are too much engaged in manufacturing pursuits to think of carrying out measures for the advancement of their art; and when seasons of commercial adversity occur they are too much depressed to make any effort for self-elevation. I trust, however, that this apathy may be dissipated, and that the British horologists, and those in the metropolis especially, will give the Institute such an amount of support as shall place it amongst the first of the scientific associations of the country.

The health of Mr. KLAFTENBERGER having been specially called for, and suitably acknowledged,

Mr. V. KNIGHT proposed that the acknowledgments of the meeting should be offered to Mr. Fielding for his admirable rendering of the music, and for his own exquisite vocalization which was the theme of general admiration.

Mr. FIELDING having returned thanks, the proceedings terminated.

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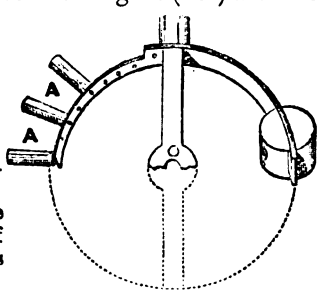
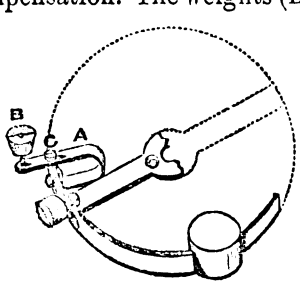
COMPENSATION BALANCE WEIGHTS.

In continuation of the subject of Compensation Balance Weights, treated of in No. 67 of this Journal, we give illustrations of two modifications of the Compensation Balance for Marine Chronometers, sent to us by Mr. Blackie. In these, No. 1 represents a Balance cut at 90° from the arm and corresponding portions of the laminated rim, reduced both in breadth and thickness nearly one-half, as shown in the engraving, to nearly the whole extent of the said rim. At the extremity of these portions of the reduced rim three fine weights (AA) are inserted for



The *under* side of the Balance is here shewn, the half *not drawn* is a counterpart.

adjusting the compensation; the opposite corresponding rims of this Balance have the ordinary compensation weight, but to laminæ of reduced thickness. Thus there are four acting laminæ, two of which are very sensitive. We are informed that practical experience shows this Balance to be capable of very nice adjustment, and when made correct for extremes, to be very close in the mean temperatures. The second balance is an auxiliary Compensation Balance, the action of which auxiliary being vertical to the plane of the balance would seem to approach the centre more rapidly in heat, and recede from it in a decreasing ratio for cold, as required for this compensation. The weights (B)on this



auxiliary are in platinum. A chronometer with this auxiliary stood first on the list of rates at Greenwich in 1858.

A shows the auxiliary curb, B the auxiliary weight, C an adjusting screw acting on the rim of the balance.

EXPLANATION OF THE NEW WATCH BARREL, WITH FREE STOP WORK, AND WITHOUT EITHER HOOK OR EYE.

Invented by A. PHILLIPPE, of the firm of Phillippe & Co., Geneva.

INVENTOR'S PROBLEM.

To obtain a mainspring capable of itself resisting its own traction during the process of winding round the barrel arbor, such traction, or slipping, not to take place in the barrel before the completion of six turns.

SOLUTION.

Find in the outer curve of the spring an elastic force superior to the central elastic force set up by the process of winding. The exertion of a spring increases with its thickness; therefore, by making that length of the spring that comes in contact with the *side* of the barrel thicker than the remainder, the adherence to the barrel becomes stronger, the force of the outer circumference is superior to the force of the inner circumference, and traction is prevented.

The next consideration is the correct proportions of this inequality essential for security, and the proper functions of the spring.

Mr. A. Phillippe has discovered the proportions and expresses them thus: "A length of the outer end of the spring equalling the inner circumference of the barrel to be left half as thick again as the remainder. This increase is gradual, and extends over a length of 15 to 20* millimetres Springs thus shaped will hold in the barrel for six or seven turns, winding by the mere pressure or elastic force of the outer turn.

The inventor has been advised concerning the many baneful contingencies

*4 to 8 tenths of an inch.

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to which watches without stop work, and possessing free springs, must certainly be destined, through the varied manipulations to which they must necessarily be subjected; therefore, however satisfactory the new spring may prove, when under careful management, the inventor thought that an equivalent for stop work should be adopted for general convenience, and has produced an equivalent, in a warning by sound, a remedy which cannot fail to be a check upon the most careless of "winders."

The inventor makes four notches in the barrel at equal distances, and the whole depth of the barrel, then bends outwards slightly the extreme thick end of the spring. By this arrangement, when the spring slips at the 6th or 7th turn of winding, the end of the spring leaving one hitch, drops into the next, causing a distinct click, indicating the uselessness of further winding. No excess of winding can produce injury.

To those who think stop work indispensable in its use, will yet have the advantage of dispensing with the hook—not a slight one.

The superiority over the old spring does not end here.

All watchmakers know the excellent effects of the bridle which is sometimes applied to springs of watches of superior make. The bridle preserves the hook from breaking, and also ensures a fuller development of the properties of the spring, a more equal tension, freedom being much increased. Independently of dispensing with the hook, the new spring possesses all the advantages which appertain to the use of the bridle, and of course is quite free from that jerking so often experienced with the common spring.

The advantages gained by the use of the new spring, without the use of the stop work, may be thus classified:—

1. Great economy in the construction of the barrel.

2. Increase in the height of the barrel.

3. Greater preservation of the spring, since its increased width will permit a decreased thickness for the same traction.

4. The setting of the inferior pivot of the arbor much better on account of the increased height and the dispensing with the squared part.

5. Watches going a longer time without winding up, say from 40 to 48 hours.

6. No danger from over winding.

7. Stopping of watches and repairs less frequent, the stop work being a great difficulty, causing much trouble.

We may add, that for repairs in general this invention offers many advantages, in being easy to substitute the new system for the old; and when a stop work becomes too deranged for use it can be dispensed with, and the free spring used. In this manner we shall be enabled to give new life to the old flat watches, by furnishing them with new barrels, which in most cases will not be indispensable.

Many years since Mr. J. F. Cole accomplished a similar result of dispensing with the stop work, by means of the key, the handle of which was formed of a cone fitting into a like hollow, without biting, and held on by a spring, the elastic resistance of which was overcome only when the main spring was wound up, and then allowed the handle to turn round without winding the watch. One advantage of this over the plan here described, was that the spring remained of uniform thickness, thereby not reducing the available space in the barrel. [We subjoin the patentee's description of the same invention from the *Mechanics' Magazine*, we have not yet any experience of its practical use in wear to be able to express an opinion as to recommending its adoption. Ed. H.J.]

This invention, patented by Mr. R. A. Brooman, of Fleet-street, consists in improvements in the springs and barrels of watches and other time-keepers hereafter described, whereby the mechanism known as the fixed stop may be dispensed with.

The patentee makes the spring as an ordinary watch or clock spring, except that he forms that part which is to become the inter-layer of the coil, thicker (as represented at *a'b''* in the accompanying engraving) than the remaining portion *a* of the length thereof. This increase in the thickness ensures a sufficient pressure to allow the rolling of about six turns or layers on the boss *b* of the arbor *c*, before

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the last layer slides against the interior face of the barrel *d*. By dispensing with the hooking of the spring to the barrel, all chance of accident is avoided, because, beyond the limit of its tension, the spring may turn indefinitely in the barrel without

injury to the watch. However, it is not sufficient simply to dispense with the cause of accident, but it is also necessary that the person winding should be advised when the proper number of turns of the spring has been attained; it might happen that the spring had not been wound sufficiently to ensure the watch going its usual time. For this purpose, on the interior cylindrical face of the barrel *d* one or more channels are cut *e*, and at the outer end of the spring is fixed a projection *f*, which fits exactly into one or other of the channels. When the spring *a* is fully wound, this projection falls into one of the channels and produces a slight click, sensible to the ear and to the touch; thus the person winding is advised that the watch is fully wound. Instead of this projection a bend may be made near the outer end of the spring, or a simple round button, in which case holes are formed in the side of the barrel instead of the channels. In some cases an analogous effect is produced by means of a steel hoop independent of the spring, and armed with a projection. This hoop also performs the function of the spring thickened at the inter end before mentioned. This hoop is provided with a hook to which the ordinary spring is attached, and upon the spring being wound it causes the hoop to slide and the projection thereon to enter the nearest channel in the interior cylindrical face of the barrel, making the click to indicate the full winding of the spring. The improved springs, before described, may be applied to all ordinary barrels, while the fixed-stop mechanism is retained. In the employment of the springs in clocks the bend near the outer end of the spring is unnecessary.

EXPERIMENTS.

COMPARISON BETWEEN THE FREE SPRINGS AND THE COMMON SPRINGS.

I.—Common Spring, 6 turns. Maximum of tension at $\frac{1}{3}$ below the setting up 112
After 3 turns..... 70
„ 4 „ 60
Loss after 3 turns or 24 hours, going 42° or more than $\frac{1}{3}$.

II.—Common Spring, 5½ turns. Maximum of tension at half a turn below the setting up 135
After 3 turns 78
„ 4 „ 60
Loss after 3 turns for 24 hours going 57° or much more than $\frac{1}{3}$.

I.—Free Spring, 6 turns. Maximum of tension 110
After 3 turns 92
„ 4 „ 82
Loss after 3 turns or 24 hours going, 18° or less than $\frac{1}{6}$.

II.—Free Spring 6 turns. Maximum of tension 110
After 3 turns 86
„ 4 „ 74
Loss after 3 turns for 24 hours going a little more than $\frac{1}{4}$.

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EXPERIMENTS MADE ON A LEVER WATCH.

The spring belonging to the watch was found to be good and more equal than ordinary. Experiment in the going with stop work, the spring fully wound up, balance described an arc of..... 555°
After 15 hours..... 510
„ 24 „ 460
„ 30 „ 425
Loss after 24 hours 95°.

Free spring of 6 turns applied to the same watch. The spring fully wound, the balance describes an arc of ..... 540°
After 15 hours 500
„ 24 „ 500
„ 30 „ 455
„ 42 „ 360
Loss after 24 hours 40°.

Experiment with a common spring with a lever or arm, otherwise an adjusting rod. Tension taken at half a turn below the maximum.... 102
First turn 92
Second „ 82
Third „ 70
Fourth „ 52
Loss after the third turn a little less than $\frac{1}{3}$.

A free spring with the lever or arm. Maximum of tension 94
First turn 89
Second „ 80
Third „ 74
Fourth „ 63
Loss after the third turn a little more than $\frac{1}{5}$.

A LECTURE ON THE MARINER'S COMPASS.

Given by Mr. RICHARD STRACHAN, at the British Horological Institute, 13th April, 1864 (E. D. JOHNSON, Esq., V.P., in the Chair.)

Magnetism, as it affects the navigation of modern ships, is necessarily a subject of deep interest to the people of all maritime nations, and it should be especially interesting to the public of this the greatest maritime nation of the world. And indeed it is so, for it has engaged the earnest attention of men of science, inventors, shipowners, shipbuilders, and of course mariners, for from them it *demands* the most careful study. Superficial knowledge of the subject will not suffice to enable the navigator to grapple confidently with the difficulties which, arising from natural and artificial causes, attend the operation of magnetism upon compasses in modern ships. But the case is different with the members of this Institute, for the most part Horologists. Although interested in practical science generally, you do not, I apprehend, desire me to lead you into the intricacies of the subject; I shall, therefore, aim principally to bring before you the leading principles of magnetism in relation to the compass, to give you, in short, the merest outline of the highly important science upon which I venture to address you.

Within the last fifty years, naval architects have been gradually introducing greater and greater quantities of iron into the construction of ships. Guns, cables, masts, bowsprits, stays, rigging, knees, tanks have been made of iron; then steam engines, with funnels, paddle-wheels, or screw-propellers, have placed many more tons of iron in ships; many ships are entirely built of iron; while, most recent innovation of all, the ships of our War Navy are being clad with an outside skin of iron, from one to eight inches in thickness, as defensive armour against the penetrative power of modern artillery. Iron, in fact, has become the chief material of shipbuilding.

Without doubt this general use of iron, both for constructive and protective purposes, is attended with numerous and important advantages; nevertheless, it

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certainly originates a very serious danger. A large amount of iron, either in the construction or in the cargo of a ship, renders that essential instrument of navigation, the mariner's compass, without the exercise of the most vigilant caution, a very fallacious guide. Mark this, and think what little security there can be in traversing the ocean without that precious guide!

To investigate the causes of this, to discover the controlling laws, and to furnish the navigator with rules and directions by which he may detect, and correct for, the compass errors, have been matters of the gravest necessity. Accordingly, they have engaged the attention of the great philosophers of the present century, who, together with the most experienced navigators, have experimented in every conceivable manner in all attainable regions of the world. Yet, after half a century of unwearied application, the subject is still in need of further investigation. Highly important practical results have been deduced, but doubtless our knowledge is still very imperfect.

I would recall to your minds the fundamental laws of magnetism; they will aid us in our subsequent considerations. First, is the law of attraction for iron, exhibited by each pole of a magnet. Second, this attractive force diminishes with the square of the increased distance of the iron from the magnet. Third, this attractive force also diminishes slightly with increase of temperature, other circumstances not altering meanwhile. Our fourth law is most important: if a magnet be supported about its centre of gravity, so as to be free to move around its support, in the horizontal plane, it will invariably arrange itself and come to rest in a certain definite position. This is the law of direction. You know already what this direction is. In our latitude it is nearly that of the meridian. That end which turns towards the north is termed the *north pole*, and the other the *south pole* of the magnet. The fifth law can now be simply enunciated; a north pole of one magnet attracts the south pole of any other magnet, and always repels a north pole. This is known as the law of polarity, and may be stated thus: similar magnetic poles repel, unlike poles attract, each other. The law of induction may be named as the sixth. Magnetic induction occurs when iron is within the effective influence of a magnet. The magnet not only attracts the iron, but while the iron is so influenced, it is rendered a virtual magnet itself, possessing poles and being capable of attracting and rendering magnetic also a second piece of iron, and so on. A great deal ought to be said upon magnetic induction, but time will prevent more. The law of neutrality will take the seventh place. It is this: when a magnetic north pole is in contact or contiguity with a south pole, the magnetic action of the weaker, or of both, if of equal strength, is destroyed, so that ferruginous bodies are not attracted, and the magnetism is said to be neutralized. An eighth law recognizes the different action of magnetism on iron and steel. Steel becomes inductively magnetic by a slow process, but then it retains permanently its acquired property. Soft iron becomes magnetic by induction immediately, but it loses its magnetism quite as soon. Hence, artificial magnets, including compass needles, must be made of the best tempered steel. A current of electricity traversing around a piece of soft iron makes it magnetic instantaneously. Hence the use of soft iron in many telegraphic instruments. A ninth law is merely a development of the fourth. If the centre of gravity of a symmetrical bar of good steel be accurately found, and the bar be supported on that point, so that it is free to move in the horizontal plane and also in the vertical plane, it will remain perfectly horizontal in any position with respect to the horizon. If, now, the same bar be magnetised, and supported as before, it cannot maintain its horizontality. Its deportment in our latitude is always as follows:—The north pole turns towards the north, and is likewise directed *downwards*. This downward inclination is termed the *dip*, and differs with the latitude. I shall have frequent reference to make to this law of the dip.

Passing then from the mention of these laws, let me dwell for a moment upon

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another important magnetic doctrine. By analogy we arrive at the conclusion that the very earth itself has the deportment of a mighty magnet. Suspend a small magnetic needle so as to traverse, horizontally, and not to dip. Place it over the centre of a large bar magnet laid upon the table. In this position it is equally attracted by each pole of the large magnet. Now gradually advance it towards one end of the bar, the needle begins to incline, and the inclination increases until over the pole it becomes quite vertical. Unlike poles will of course be attracting. Move the needle back and towards the other pole, it first becomes horizontal at the centre, then the opposite pole inclines in a similar manner. The phenomena of the horizontal and of the dipping needle, as observed in every region of the globe, are in all respects analogous to the deportment of the needle and bar magnet. In the northern part of British America there is a locality where the dipping needle is vertical, and towards which the horizontal needle points from all quarters. A similar locality is found to the south of Tasmania. These may be regarded as the earth's magnetic poles, while near the equator the dipping needle is horizontal all round the world, completing the analogy of the magnet.

Further, in order that I may the better complete this cursory glance at the leading principles of magnetism, let me tell you that at no place is the direction of the dipping-needle, nor of the horizontal-needle absolutely constant. They have secular, annual, even diurnal variations, but more, they are subject to occasional erratic perturbations so to say. These changes can only be detected by refined methods and apparatus. The abnormal fluctuations have received the name of magnetic storms. It must suffice to say here that magnetic storms, atmospheric commotions, earth electric currents, spots on the sun, auroral lightnings, are believed to have a certain interdependence.

I do not intend to trouble you with an historical account of the compass, further than to state that it was known to the Chinese many centuries before the commencement of our era; while even the Phœnicians, Greeks, and Romans, who knew the attractive property of the loadstone, certainly never possessed a compass. It was not known in Europe until after the Crusades. The honor of the invention has been given to a Neapolitan, named Giogo, but it appears that he can only claim merit for having attached a magnetic needle to a compass-card, as we now use it. The Chinese compass, both ancient and modern, consists of a needle traversing above a fixed graduated circle. Land compasses, used at the present day, are similarly constructed. But the advantage of the floating card for the sea compass is proved by its universal use. The direction of the magnetic needle coincides only in certain regions with the true direction of north and south as determined astronomically. The angular difference is termed the variation of the compass. Columbus discovered that the variation was not the same everywhere. An Englishman, named Norman, discovered the dip. Captain Cook first noticed the local error of the compass arising from the magnetic character of the ship itself.

[The usual construction of a binnacle compass was then described—the needle with its counterpoise and sliding weights for counteracting the dip in different geographical positions—the needle-cap with its agate centre—and the pivot for supporting the needle—the bowl with its glass, gimbals, and lubber's line.]

Compass-bowls are usually made of copper. The gimbals answer the same purpose as in the chronometer, that of maintaining the pivot vertical under every movement of the ship. The centre of the needle should be a ruby or an agate, and the pivot a hard metallic point. The best form for compass-needles is the straight-edged, that is deep vertically but narrow, so that the line of magnetic direction may, under all circumstances, be confined as nearly as possible to the middle line.

(To be concluded next month.)

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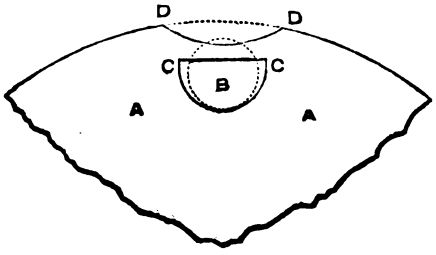
TO THE EDITOR OF THE HOROLOGICAL JOURNAL.

SIR,—The value of the two-pin roller to the lever escapement is too well known to require any comment of mine; but it is subject to the serious defect of the pins cutting and wearing away, which has led to the adoption in their place of the ruby pin, in the form of a prism. But this also labours under the disadvantage of being somewhat difficult to execute; consequently it can only be entrusted to a superior workman. I propose, therefore, to show how the ordinary round pin roller can be made to possess all the advantages of the other two, viz., by transforming it from a cylindrical to a semi-cylindrical pin.

To do this I proceed in the following manner: I take a somewhat larger pin than is generally used, and flatten it away one-third. To plant it I drill the hole as near the edge of the disc as I can without it bursting out. I then place a hard-tempered staff, flattened to correspond with the pin inside the hole to protect it, while I form the passing hollow with a small punch. I have enclosed a small piece of steel showing the whole process at one glance. I have also attached, for the convenience of handling, a finished roller. The possibility of this improvement occurred to me a few days since, and I now submit it for your inspection, if it should meet with your approbation. I must leave it with you, to take what course you think necessary to bring it under the notice of the trade, more especially that portion of it devoted to the escapement making; and remain, sir, your most obedient servant,

JOHN OVERTON.

Percy-street, Coventry,
March 23, 1864.



In the drawing A A represents (enlarged) a segment of a roller to the lever escapement. B the form of the hole for the ruby pin as first made. C C the semi-cylindrical shape it is driven into by punching down the passing hollow from the circumference at D D. This method of obtaining a flatted ruby pin fitting has been in use for years in London, although not generally adopted, it is more worthy of notice, and we therefore publish our correspondent's letter upon it, to bring more generally under the notice of the escapement maker the advantage of the flatted ruby pin, which, while it affords all the impulse possible, gives a safe guard with a light locking, while a common liability to error arising from contact with the bottom of the lever notch, from wide holes, &c. is reduced. We must add that our correspondent errs in concluding that this is all that constitutes the escapement known as the two-pin lever of Savage, which receives impulse in quite a different manner, and in which the function of the two pins is to unlock only. ED. H. J.]

FRAUDULENT TRADE MARKS.

Early in the present year an important act of Parliament, the main provisions of which it concerns all persons engaged in trade of every description to know, came into practical operation for the first time.

Its short title is "The Merchandise Marks Act, 1862," and it makes it a misdemeanor to forge or counterfeit any trade mark, or falsely to apply any such trade mark, with intent to defraud, whatever the article to which it may be applied, whether it be a cask, bottle, stopper, vessel, case, cover, wrapper, band, reel ticket, label, or any thing in or with which any commodity is sold, or intended to be sold.

Again, it is from henceforth an offence for any one to sell or expose, either for sale or for any purpose of trade or manufacture, articles with forged or false trade marks attached, the penalty being the forfeiture of a sum of money equal to the value of such article, and a sum, besides, not exceeding £5, nor less than 10*s*.

By another provision, every addition to, and every alteration and imitation of, any trade mark made with intent to defraud—the intent being of the essence of the offence in all cases—are to be deemed forgeries, and punishable as such—namely, in addition to the penalties for misdemeanor, by the forfeiture of every instrument used for the purpose of the fraud, and of every article to which such false mark shall be applied.

It is made obligatory on every person, who shall sell an article having a false trade mark, to give information, on a demand in writing being made upon him, as to where he procured it; and power is given to justices of the peace to summon parties refusing or neglecting to afford such information, and in the event of their persisting in their neglect or refusal, to impose a penalty of £5.

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Further, to mark any false indication of quantity upon an article with intent to defraud is made punishable by a penalty equal to the value of the article, and the payment of an additional sum not exceeding £5, and not less than 10*s*.

The provision will apply, among other cases, to ale sold in bottles, and to cotton reels, and the like on which the contents are falsely denoted.

A conviction under the power of the act is not to effect any right or civil remedy to which any person aggrieved may be entitled at law, in equity, or otherwise; nor in any indictment, information, or proceeding under its provisions need an intent to defraud any person in particular be alleged or proved. The punishment or conviction of any offence, which by the act is made a misdemeanor, is to be at the discretion of the court, imprisonment for not more than two years, with or without hard labour, or by fine, or both by imprisonment, with or without hard labour and fine, and also by imprisonment until the fine (if any) shall have been paid and satisfied. The time within which any action or proceeding may be commenced for the recovery of penalties or procuring a conviction is limited to three years next after the commission of the offence, or one year after its first discovery by the person proceeding.

There is a clause according to which the vendor of an article with a trade mark is to be deemed to warrant or contract with the purchaser that the mark is genuine, unless the contrary shall be expressed in some writing, signed by or on behalf of the vendor, and delivered to and accepted by the purchaser. The seller of an article, too, with a description upon it of quantity, is to be deemed to contract and warrant that description is true, unless, as before, the contrary shall be expressed in writing, delivered and accepted by the buyer. This again will apply to the familiar example among others of pale ale sold in bottles, on which the contents are indicated.

In suits at law or in equity against persons for using forged trade marks, the court may not only order the article to be destroyed, but may, by injunction, command the defendant to forbear from repeating the offence upon pain of contempt of court.

[There is, perhaps, no business to which trade marks and the protection they are intended to afford are of more value than to the Watchmaker. Very numerous are the instances where an inventor has sacrificed the hard earned savings of years to secure the originality of his title, or to prevent its appropriation by others, and this frequently by provisional specification only, thereby losing all prospect of personal profit from the working of his invention exclusively for a short period. The impress of the trade mark on his production would secure to the inventor all the advantages of such a course as that above alluded to, by identifying him with its production.

There seems to be, however, fully to accomplish this desirable object, a want not supplied by the Act, *i. e.* a registration of such marks, whereby a verification could be effected.]

ED. H. J.

NOTICES TO MEMBERS.

We again call the notice of our readers and of the trade generally to the admirable Portrait of Thomas Earnshaw, author of the present Chronometer Escapement. As all the first proofs of this valuable engraving are not yet subscribed for by our members, we wish particularly to advise those who desire to possess a copy, and have not sent in their names, that the plate is not the property of the Institute, and that the distribution of these first proofs has been granted as a compliment. The connection with the publication or issue will cease with the impressions now in hand. It is most probable, when placed in the hands of a regular publisher, the price will be much enhanced for what will be of course less valuable impressions.

OBITUARY.

We regret to have to record the death of Mr. R. H. ROTHERHAM, of the firm of Rotherham and Sons, watch manufacturers, Coventry. The deceased gentleman had been connected from his boyhood with the firm of which he was the head, having served an apprenticeship to the trade. He was distinguished by an active benevolence, and generous disposition; and as founder of that excellent Institution, the Coventry Watchmakers' Widows' and Orphans' Aid Society his name will long be held in affectionate remembrance. The estimation in which he was held by his workpeople is best evinced by the fact of their having a few years ago presented him with a splendid piece of plate of the value of 100 guineas, on the occasion of his having completed 50 years in the business. In his death British commerce loses one of its worthiest sons, and his native city one of its most honoured citizens. Mr. Rotherham was in his 75th year. The firm of which he was senior partner have been members of the Institute almost from its commencement.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., MARCH, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F, and mean sea level	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9A.M.	During the next 24 hours
	inches.	°	°	°	°				
1	29·833	40	39·5	42	33·5	SSE	3	o	mr
2	·832	32·5	32	42	30·5	NE	1	m	om
3	·738	37	36·5	47	32	ENE	2	m	rr
4	·595	46	45·5	46	37	WSW	2	m	bc, m
5	·482	43	42	54	39	ESE	1	m	o, rr
6	·147	41	40	47	39	ESE	2	r	r, c, pq
7	28·975	42·5	41	52	40·5	SSW	6	or	o, r
8	29·046	44	43·5	51	42	S	1	m	om, r
9	·128	36	35	45	36	NNE	3	rs	ss
10	·716	33	31·5	36	27	SW	1	cb	o, r
11	·619	47·5	45·5	47·5	32	SW	7	cb	qp, c
12	30·103	41·5	39	50	35	SW	5	b	b
13	·283	41	40	49	35	W	5	cb	cb, p
14	·090	48	46	51	40	W	6	c	cb, op
15	29·844	48	47	55	46	WSW	7	o	o, r
16	30·130	37	36	51	34	NE	3	cb	bc
17	·205	38	36·5	48	31·5	SE	3	o	bc
18	29·900	34·5	33	42·5	29	ESE	4	b	b
19	·696	39	37	45	32	E	4	b	b
20	·661	41	39	53	33	E	4	b	b
21	·713	40	39	55	35	ENE	3	o	o, bc
22	·707	41·5	40	50	38	ENE	3	o	o, c
23	·914	38	37	45	36	NE	4	o	c, b
24	30·058	35·5	34	50	29	ESE	1	mb	f, b
25	29·800	36·5	35	47	30	E	1	mb	bc, m
26	·577	42	40	45	36	N	2	cb	c, r, o
27	·624	36	34·5	45	29·5	NNE	6	c	op
28	·460	44	41·5	45	33·5	W	5	c	c, hq, p
29	·233	38·5	36·5	47	33	NNW	7	c	hq, r, ss
30	·525	36	35	47	32	NNW	2	m	r, o
31	·838	43	41	43	32	WSW	3	c	o, ppq
	29·693	40	387	47·5	34·5	—	3·5	—	—

REMARKS.

The barometric pressure was 28·948 at 10 a.m., 7th, and 30·283 at 9 a.m., 13th; these give 1·335 inches for the extreme range.

Gales occurred on the 7th, 11th, 15th, and 29th.

Rain, including hail and snow, fell on 18 days, during about 90 hours, to the amount of 2·83 inches.

The relative prevalence of the winds was N., 6; E., 11; S., 6; W., 8 days.

The characteristics of the month were low barometric pressure, much humidity, low and variable temperature, and strong winds.

EQUATION OF TIME TABLE.

For May, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *added* to Apparent Time	Difference for One Hour.	At Mean Noon. — Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Sun . .	1	3 4.99	0.304	3 5.01
Mon . .	2	3 12.00	0.280	3 12.01
Tues . .	3	3 18.42	0.256	3 18.43
Wed . .	4	3 24.29	0.233	3 24.30
Thur . .	5	3 29.59	0.209	3 29.60
Fri . . .	6	3 34.32	0.185	3 34.33
Sat . . .	7	3 38.49	0.162	3 38.50
Sun. . .	8	3 42.08	0.138	3 42.09
Mon . .	9	3 45.10	0.115	3 45.11
Tues . .	10	3 47.57	0.091	3 47.58
Wed . .	11	3 49.48	0.068	3 49.48
Thurs .	12	3 50.84	0.045	3 50.84
Fri . . .	13	3 51.64	0.022	3 51.64
Sat . . .	14	3 51.88	0.001	3 51.88
Sun . .	15	3 51.58	0.024	3 51.58
Mon . .	16	3 50.72	0.047	3 50.72
Tues . .	17	3 49.32	0.070	3 49.32
Wed . .	18	3 47.38	0.093	3 47.37
Thurs .	19	3 44.89	0.115	3 44.88
Fri . . .	20	3 41.86	0.138	3 41.85
Sat . . .	21	3 38.29	0.160	3 38.28
Sun . .	22	3 33.19	0.182	3 34.18
Mon . .	23	3 29.54	0.204	3 29.54
Tues . .	24	3 24.41	0.225	3 24.40
Wed . .	25	3 18.74	0.247	3 18.73
Thurs .	26	3 12.55	0.268	3 12.54
Fri . . .	27	3 5.88	0.289	3 5.87
Sat . . .	28	2 58.71	0.309	2 58.69
Sun . .	29	2 51.07	0.328	2 51.05
Mon . .	30	2 42.96	0.347	2 42.94
Tues . .	31	2 34.39	0.365	2 34.37

ADVERTISEMENTS.

	s.	d
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Each additional line	0	4
Situations and Apprentices, 2 lines	0	6
Each additional line	0	3

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Five per cent. discount on the above charges if three or more insertions are paid for in advance; and ten per cent. on six or more insertions.

N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 23rd of the month.

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A LECTURE ON THE MARINER'S COMPASS,

Given by Mr. RICHARD STRACHAN, at the British Horological Institute, 13th April, 1864. (E. D. JOHNSON, Esq., F.R.A.S., V.P., in the Chair.)

(*Concluded from page* 105.)

The card of sea compasses invariably has the magnetic needle fixed to it, usually below, and great care is requisite to ensure the centre of the card being precisely over the point of the pivot, when mounted in the compass bowl. Over the end of the needle which points to the north, the letter N., or the *fleur de lis*, is marked on the card; over the south pole the letter S. is placed. The line joining N. and S. should pass through the centre of the card, and be parallel to, and vertically over, the line of direction of the magnet. Looking towards the N. point, ninety degrees to the right hand is marked E., to the left W. Midway between N. and E. is termed N.E. The point between the N. and N.E. is called N.N.E., between E. and N.E. it is E.N.E. The method of naming is easily understood. We have only to combine the letters on either side to get at the intermediate points for the first sixteen divisions. Dividing these again, thirty-two points are formed, and the last sixteen are named with a reference in the first place, to that adjacent point which has the shortest name, using the word *by* to connect it with that one of the four principal points to which it is nearest. Thus, between the N. and N.N.E. the point is termed N. by E.; between N.E. and E.N.E. is the N.E. by E., and so on for the other quadrants. Should smaller divisions of the circle be necessary, the distance between the points may be halved or quartered; thus, a quarter of a point from the N.E. going towards E. is N.E, ¼ E., &c. Again, instead of the divisions by *points* the circumference of the card may be divided into degrees, and even to ten minutes of arc. The two modes of division are applied to the card before us, which belongs to what is termed an *Azimuth Compass*.

This compass is so called because it is used chiefly for observing the angular distance in the horizontal plane of celestial bodies, from the S. or N. points, which measurement is known by the Arabic name *azimuth*. This compass differs from the binnacle compass in the following particulars. It possesses a metallic circle, having fixed on its circumference a sight vane, with prism and coloured glasses attached, and diametrically opposite to this a narrow frame, hinged on so as to be capable of being placed vertically, and in which is stretched a fine wire or thread, having behind it a reflector, moveable on a hinge, with stiff friction. The use of all this you will perceive from a brief description of the method of observing with this compass. Suppose it is desired to observe the azimuth of the sun. The compass being supported in its gimbals, and also mounted, as we have it here, on a tripod stand, the observer faces the sun, and turns the metallic circle, which is made to move round the centre, over the compass glass, until the sight vane comes before his eye. He then directs his attention to the reflector, and moves it on its hinge until it throws a reflection of the sun upon the vertical wire. He next carefully moves the circle until the wire appears to bisect the sun's image. At this instant he directs his vision to the prism, which he can do without losing sight of the wire, and he reads the degree of the card apparently immediately underneath the wire, and in a line with it, but in reality it is the reading of the card under the prism that he sees. For the prism reflects the light thrown up from the part of the card below it, at right angles, so as to enter the observer's eye horizontally, and the surfaces where the light enters and leaves the glass of the prism being properly rounded, act like those of a magnifying glass, and enable the observer to read to the sixth part of a degree. The coloured glasses are moveable in front of the sight vane, and are intended to shield the eye from the glare of the sunlight, similarly to those used with sextants and telescopes.

Doubtless you wish to know for what purpose such an observation is required.

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It must suffice for the present to say, that this observation can be compared with the true bearing of the object, and thereby the error of the compass ascertained. When I point out to you the various sources of error in the mariner's compass, I think you will agree with me, that no ship should go on a long voyage without this admirable instrument.

We have now, therefore, to consider the compass errors. The angle made by the direction line of a magnet and the meridian, or true north and south line of the place, is called the *variation* of the compass for that place. The variation must be considered an error of the compass, since it differs at different parts of the world. The laws of the variations are, however, now so well established, and such excellent charts of the variation exist, that if this were the only error of the compass, the azimuth compass could not be deemed an essential instrument of navigation. All modern ships having large quantities of iron in their construction, exert a local attractive influence upon the magnetic needle, which differs in direction and amount when the ship's head is in different positions, when the ship lists, or leans over on one side; and these different errors alter with change of geographical position. The error thus caused by the ship itself is called the *deviation* of the compass. It tends either to enlarge or diminish the error of variation. You see at once, therefore, the importance of studying this part of our subject.

Another cause of error is the influence which lightnings, and also the aurora, probably have upon magnets. Cases have occurred in which the poles of a magnetic needle have been reversed by a stroke of lightning; and the auroræ have been observed to render the compass very unsteady and uncertain.

The navigator has to concern himself daily, however, about the error of variation combined with deviation. This error can be ascertained at sea by the following methods: — The bearing of the sun at noon, and of the pole-star, whenever visible, affords a rough method of detecting the amount of error of the compass from the true meridional direction. With the approximate time of rising or setting of the sun, moon, or star, and the latitude of the ship, the amplitude of the celestial object, that is, its distance from the E. or W. points of the horizon can be computed; and, having observed the same by means of the azimuth compass, the difference gives the error of the compass. If the bearing of a celestial body be observed at a proper and well-known instant of time, the true bearing can be computed for that time, the latitude being also known; and, as before, the error is obtained by comparison. Again, when the time is only approximately known, if the altitude—that is, the vertical angular distance above the horizon, as well as the bearing of the object be observed, the latitude being known, the true azimuth can be computed therefrom, so that the compass error is found by comparison as before.

By comparing the error found by any of these methods, with the variation due to the place as shown by a good chart, the deviation for the position of the ship's head at the time of observation, if large, will be readily detected.

And now, some explanation is necessary as to the error of *deviation*. A ship containing much iron—much more an iron ship—becomes itself magnetic by the inductive action of terrestrial magnetism. The magnetic inductive action of the earth takes place in the direction of the dipping needle, when in the plane of the magnetic meridian. Hence ships obtain a magnetic state while building, peculiar to the position; and this state alters more or less rapidly when launched and placed in different positions. This magnetic state never assumes a permanent character. It is modified by a variety of conditions, as change of local situation, change of geographical position, lapse of time, and alteration of structure or stowage. The hammering of artificers, or the battering of the waves, may materially alter the magnetic condition of an iron ship. As a general rule, the iron of the ship draws the north pole of the needle towards the ship's head. When the ship's head is towards the magnetic north or south, the attraction of the ship, in most cases, acts

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in the same direction as that of the earth upon the needle, so that in these positions of the ship there is usually little or no deviation. When the ship's head is directed towards the east, or the west, the deviation is usually at its maximum.

In some ships the amount of deviation is not the same when the vessel inclines as it is, upon an even keel. As a general rule, the north pole of the needle is drawn to the high or weather side of the ship, at least, in north latitude. The *City of Baltimore* swung at Liverpool, with her head due magnetic north, on an even keel, her standard compass had an error of 7½° W., when heeled 10° to Port, it was 15½° E., and when listed 10° to starboard, it was 25½° W., showing a difference of 41° due to heeling alone. When an iron ship inclines, the upper portions of the beams and bulwarks instantly acquire south polarity, in regions where the north pole of the needle dips; and this south polarity must always be attractive of the north pole of the compass-needle. In a ship which has been built head to north, the after part has decided south polarity, and this being the part in which the compass is placed, this cause combines with the heel to produce the deviation of the needle from the magnetic north. In a ship built head to south, the deviation will be the result of the difference of the forces brought into play by the two causes, as the after part of the ship would then have acquired north polarity; ships built with the head to east or west, ought then, according to this theory, to show a minimum result for the acquired polarity, since this position is the least favourable for magnetization by the inductive influence of the earth. As the deviation, whether on an even keel or with heel, arise from induced magnetism, and as this will change in polarity in the southern hemisphere, it must follow that the deviation will likewise alter. Carefully conducted observations bear out the theory. Generally it is found that the maximum deviations from heel occur on magnetic north and south courses, while there is, practically, no deviation from heel on east and west courses. To test, whether a ship's compasses will be affected from heel or not, she should be listed over, both to starboard and port, with her head to the magnetic north or south, if the vessel had been built with her head to north or south. The deviation from heeling for the other points will be found sufficiently well for practical purposes by multiplying the observed deviation from heel by the sign of the angle from east or west.

It is the practice to examine iron ships before leaving Port, in order to ascertain the nature and amounts of the deviations of the compasses. For this purpose the ship should have her stores, cargo, or armament on board; and either by the action of the tide, or by means of warps, she should be swung or turned round, so as to bring her head to the N.E., S.E., S.W., and N.W. points, or preferably upon each of the thirty-two points; then the errors of the compasses due to local attraction may be found by either of the following methods:—

1st. A compass or theodolite being conveniently placed on shore, transverse bearings of the ship and shore compasses are to be taken. The bearings should be diametrically opposite, if they are not, the discrepancy is due to the attraction of the ship, and the amount is the deviation for the then position of the ship.

2nd. A fixed object may be selected so distant, that its bearing from the ship's compass would not be sensibly altered by the small change of place which occurs as the ship swings round. Bearings of this object being observed with the ship's head on different points of the compass, and afterwards compared with the true magnetic bearing, the deviation errors are found in the differences.

3rd. A simple method was devised by Mr. Stebbing, at Southampton, which requires an arrangement of poles in the arc of a circle, with one pole in the centre of the circle, so situated on shore as to be conspicuous from the shipping. When from a ship lying off the shore, the centre pole is observed to cover a pole on the circumference, it is known, from the plan of the arrangement, that the direction should be so and so by compass; if it is not found to be so the difference is the deviation.

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4th. A plan, very similar, but much more extensive and available than the last, has been carried out at Liverpool. On the walls of the Docks, which extend for several miles facing the river, conspicuous marks and devices are painted, which have reference to a tall factory chimney, in the heart of the town, known as the Vauxhall chimney. When any one of these marks is observed to be immediately in front of the chimney, it is known that this is a certain magnetic direction, and if the compass does not show the same direction, the difference is deviation.

[These methods were illustrated, and of course made clearer than a few words can make them, by means of diagrams. The nature of the error produced in a ship's reckoning by not allowing for even a small amount of deviation, was also explained by diagram.]

Various plans have been proposed for counteracting, or compensating as it is termed, the deviation of the compass. Professor Barlow devised a very ingenious method. A wood pillar is erected near the compass, having a series of horizontal holes in it. A disc of iron is mounted on a spindle so as to fit into any of the holes. By trial, while the ship is being swung to ascertain the deviation, a hole is found for the spindle, where the attraction of the iron disc doubles the deviation due to the ship, and another, where it counteracts the deviation; and a record is kept of these positions. This is done for various directions of the ship's head. It was imagined, from theoretical considerations, that the whole effect of the ship's iron upon the compass would be counteracted by this plate acting magnetically upon the compass, whenever and wherever it was adjusted to its position proper to the direction of the ship's head as found by trial; so that the navigator could neutralize the deviation, or double it, and so ascertain its amount whenever he pleased. Exceedingly charming is the theory, but unfortunately it does not conform to nature. This mode of correction is ineffectual, because the resultants of the magnetic forces of the plate, and of the ship as regards direction and magnitude cannot remain equal and opposite, or coincident, with change of terrestrial magnetic intensity.

Professor Airy's plan has been more successful. He investigated the magnetism of ships experimentally, and treated his results mathematically. According to his treatment the subject is one of the most abstruse, and few, if any, seafaring persons can hope to master his analysis. The practical result is that the deviation can be destroyed by a proper adjustment of masses of soft iron and strong permanent magnets. The process of adjustment is one of trial and error, and the ship must be swung for the purpose. Experience seems to prove that this method is efficacious in reducing the amount of deviation; but that it entirely corrects for it in every latitude, can no more be expected than that Barlow's plate should be effective. In southern latitudes it is frequently necessary to shift the corrective magnets; and sometimes they so perplex the navigator that he finds it advisable to remove them altogether.

In concluding this mere outline of magnetism, as connected with the mariner's compass, I think I may venture to say that acquaintance with the laws of magnitism, particularly a thorough knowledge of the principles, construction, use, and methods of correction of the compass, as well as the absolute necessity of ascertaining the local magnetic action of the ship on its compasses, and of duly allowing for it, you must evidently see has an importance which cannot be estimated too highly.

Mr. Johnson, remarked that the lecture exemplified how the sciences dove-tail, as it were, into each other. The identical means by which Professor Barlow proposed to correct the errors of the compass, enabled him to ascertain that the performance of chronometers was affected by magnetism. In complimentary terms he proposed a vote of thanks to the Lecturer, which being carried, and suitably acknowledged, the proceedings terminated.

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ASSAYS OF WATCH CASES.

It appears, from a parliamentary return just issued of the number and value of watch cases assayed and marked at the various assay offices of the United Kingdom, during the last fourteen years, that the total number of gold cases assayed, during that period, amounted to 463,001. Of this number 318,923 were marked in London; 139,899 in Chester; and 4,179 in Birmingham. The number marked at Goldsmiths' Hall increased from 16,878 (weighing 22,191 ozs.) in 1850, to 26,996 (weighing 39,757 ozs.) in 1860, since which period the number has declined. Of the total number marked in London, 316,347 were of 18 carat gold. The Goldsmiths' Company have no knowledge of the value, except that of the intrinsic value, as indicated by the weight and quality of the gold. In Chester the number of gold cases rose from 4,658 to 13,317, and the weight from 6,230 ozs. to 15,895 ozs. Of the total number assayed 134, 114 were of 18 carat gold. The number of gold cases marked in Birmingham has undergone a great diminution during the last fourteen years, the numbers for the years 1850 and 1863 being 736 and 36 respectively. Neither the weight nor quality of the gold is stated in the return. No cases of a higher standard than 18 carat were assayed in Chester, but 85 cases of 22 carat gold, weighing 236 ozs. 11 dwts. 20 grs. were marked at Goldsmiths' Hall during the period specified. Gold cases of a lower standard than 18 carat do not appear to gain favour either with the trade or the public, the number marked in London and Chester having considerably diminished during the last four years, as will be seen by the following table.

NUMBER OF GOLD CASES OF 15, 12, AND 9 CARAT GOLD MARKED IN LONDON AND CHESTER, FROM 1855 TO 1863 INCLUSIVE.

	LONDON.				CHESTER.				Grand Total.
	15 Carat.	12 Carat.	9 Carat.	Total.	15 Carat.	12 Carat.	9 Carat.	Total.	
1855	34	223	144	401	166	1,132	151	1,449	1,850
1856	116	674	186	976	208	263	360	831	1,807
1857	123	300	80	503	147	197	832	1,176	1,679
1858	64	143	5	212	24	105	42	171	383
1859	68	138	14	220	2	74	449	525	745
1860	67	40	12	119	17	38	22	77	196
1861	2	24	2	28	—	60	151	211	239
1862	18	4	4	26	25	42	9	76	102
1863	1	4	1	6	18	48	18	84	90

The weight of gold cases of the different standards, marked in London and Chester, is as follows :—

	18 CARAT.			15 CARAT.			12 CARAT.			9 CARAT.		
	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.
London ...	463,616	2	13	633	17	1	2,034	13	9	729	1	23
Chester ...	172,468	0	0	902	0	0	2,562	0	0	3,219	0	0
TOTAL ...	636,084	2	13	1,535	17	1	4,596	13	9	3,948	1	23

The assay master at Sheffield writes that he has searched the books of the office from 1850 to the present time, and does not find that any watch cases, either gold or silver, have been assayed or marked there during that time, and that

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he is not aware that there are any makers of them in Sheffield.

The number of silver cases marked at Goldsmiths' Hall rose from 62,076 to 77,608, and the weight from 114,053 ozs. to 147,830 ozs., with a decrease during the last two years. In Chester the number rose from 11,264 to 21,150, and the weight from 19,555 ozs. to 35,488 ozs.

In Birmingham, where the fees upon silver watch cases are taken by weight, the returns show a great diminution in the quantity assayed; in 1850 the weight amounted to 40,377 ozs., in 1863, to 13,913 ozs. The total weight marked there, during the fourteen years, amounted to 399,110 ozs., and this, added to 2,302,192 ozs. marked in London, and 436,062 ozs. marked in Chester, gives a grand total of 3,137,364 ounces of silver watch cases marked in this country during the last fourteen years.

Appended to the return is an account of the number and computed real value of foreign watches imported into the United Kingdom from 1850 to 1863, inclusive. This return, however, is, to a great extent, incomplete, inasmuch as prior to 11th June, 1853, neither the number nor the description of watches imported, but only their value, on which the duty was chargeable at a uniform rate, was required to be stated in the entries at the Custom House. The value of the watches so entered amounted in 1850 to £97,014; in 1851 to £101,286; in 1852 to £146,970; and in 1853 (to June 11th) to £63,128. From 11th June, 1853, to 3rd March, 1860, watches were entered by number as pertaining to one or other of the two classes then recognized in the application of the duties, namely, watches of gold, or any other metal, exceeding in value £10 each, and watches of silver, or any other metal, not exceeding in value £10 each; the number of the former decreased from 43,828 in 1854, to 27,574 in 1859, and the value from £185,554 to £115,153, whilst the number of the latter increased from 66,578 to 73,041, and the value from £88,397 to £98,408. Since the repeal of the duty in 1860, gold watches have been required to be distinguished from those of other metals, and since then the importations have been as follows:—

	Of Gold.		Of Silver, or any other Metal except Gold.		Total.	
	Number.	Value. £	Number.	Value. £	Number.	Value. £
1860, from 3rd March.	36,785	154,759	99,300	155,306	136,085	310,065
1861	42,907	155,723	127,744	175,842	170,651	331,565
1862	30,126	104,498	131,402	159,269	161,528	263,767
1863	35,486	115,462	125,162	140,901	160,648	256,363

H.B.

GOLD AND SILVER WARES.

By a return furnished to the House of Commons, dated July 27th, 1855, it appears that the average receipts by the Goldsmiths' Company for assaying and marking Gold and Silver Wares, during the previous ten years, amounted to £4,401 per annum, while the average annual expenditure during the same period, including a sum of £390 per annum for annuities to superannuated servants, and £107 per annum for legal expenses incurred in the prosecution of offenders, amounted to £4,037—this gives a net income or profit of £364 per annum, something under nine per cent., a modest return on the labours of a staff represented by fourteen persons.

The details of the return are as follow:

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No. 1.—The sums of money received by the Goldsmiths' Company for Assaying and Marking GOLD and SILVER WARES for each of the last Ten Years.

		£
For the Year ending Lady Day	1846	4,473
	1847	4,382
	1848	3,844
	1849	3,416
	1850	3,612
	1851	3,795
	1852	3,970
	1853	4,697
	1854	4,866
	1855	4,492*

No. 2.—The annual amount expended by the Goldsmiths' Company in Assaying and Marking GOLD and SILVER WARES for the last ten years.

		£
For the Year ending Lady Day	1846	4,179
	1847	4,012
	1848	4,240
	1849	4,094
	1850	3,676
	1851	3,756
	1852	3,291
	1853	4,253
	1854	4,061
	1855	3,739

No. 3.—The number of persons employed in Assaying and Marking GOLD and SILVER WARES, with the amount of their salaries.

The number of persons - - - - - Fourteen

The amount of their salaries - - - - £2,469 per annum†

N.B.—The annuities to superannuated servants, amounting to £390, are included in the annual amount expended, No. 2.

* In addition to the foregoing sums, the sale of the Diet Silver has produced on an average, £247 per annum.

† In addition to which, three of the officers have houses allowed them free of rent, rates, taxes, and repairs.

No. 4.—The amount of LEGAL EXPENSES incurred for the last ten years in prosecutions against offenders, by the Goldsmiths' Company.

£1,074.—This sum is not included in the above-mentioned annual expenditure.

JOSIAH SHARP,
Deputy Warden.

Assay Office, Goldsmiths' Hall,
6th August, 1855.

EDINBURGH HOROLOGICAL SOCIETY.

The second anniversary dinner of this flourishing society took place on Saturday evening, April 16th, in the Ship Hotel, Register Street, Mr. David Meek, the President, in the chair, and Mr. John McKay, Vice-President, croupier. Above twenty members of the society were present. After the usual loyal and patriotic toasts were given and responded to with enthusiasm, Mr. Meek proposed the toast of the evening, "Success to the Edinburgh Horological Society," and in doing so gave a brief and lucid history of the progress of the society during the past year, and expressed a hope, that as the principal employers had begun to take an interest in the society, there would be still greater exertions made by the members to forward its objects. After an agreeable evening of a social character, the proceedings terminated about eleven o'clock.

We have received a letter from Mr. WILLIAM THICTHENER, of 31, Wynyatt Street, Clerkenwell, complaining of the misrepresentation and appropriation by others of his improvement upon the Gold Three-Pin Lever Escapement, the substance of which we publish at his own request. It runs thus:—

SIR: Having received intelligence, through a gentleman, that my improvement upon the Gold Three-Pin Lever Escapement has been misrepresented and

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appropriated by others, I should feel much obliged if you would kindly insert my name and address in the Horological Journal, as the person to whom alone the credit of the invention is due, as I was the first to reverse the Escapement to the Solid Impulse Lever, which imparts to it greater solidity and security; and I also greatly improved the action of the same by my introduction of the Jewelled Lever, as well as simplifying and reducing the friction, which qualifies it for the best chronometer watches; as it is very hard and discouraging to the working man to have his name kept in total oblivion by false representations, I trust you will favour me by inserting this as a public refutation.

I am, Sir, your obedient servant,
WILLIAM THICTHENER.

[In our next Number we propose giving a drawing of the modification of the Three-pin Lever Escapement referred to in the above letter. ED. H. J.]

AN

ACCOUNT OF SOME EXPERIMENTS MADE TO DETERMINE THE THERMAL EXPANSION OF MARBLE.

BY JOHN DUNN, OPTICIAN; AND EDWARD SANG, LECTURER ON NATURAL PHILOSOPHY, EDINBURGH.

[*Read before the Society of Arts for Scotland, 30th March*, 1831, *and published in the Edinburgh New Philosophical Journal for June*, 1831.]

IN the construction of clock movements and of metrical standards, we are constantly harrassed by the expansion and contraction of the parts.

As soon as the fact that bodies expand by heat became known, the question must have arisen, "Does any substance exist which is not liable to this change of volume?" Many have been the experiments made to determine the rate of expansion of different bodies; but although some bodies have been found, of which the elongation is exceedingly small, in none, as yet, has it been discovered to be awanting.

The construction, on the supposition that marble is inexpansile, of a marble clock pendulum for the Royal Society of Edinburgh, a description of which was read at our last meeting, and previously, we understand before the Royal Society itself, can hardly have failed to have excited a considerable sensation among those who are practically acquainted with the many inconveniences which attend a change of temperature, or to have created some curiosity about the manner in which such a singular fact was arrived at.

The analogy from which the inexpansibility of marble was deduced, at first sight plausible, will not bear a rigid examination. Granting, though it has not been confirmed, that a regularly crystallized piece of calcareous spar changes its shape but not its volume on being subjected to a change of temperature; this only shows that, when disposed in a peculiar manner, the particles of carbonate of lime approach in one direction, and recede in others, so as to retain the same aggregate volume. We are by no means at liberty to infer, that irregularly disposed particles, or even crystals of this substance, are acted on in the same way; the very fact of their accidental distribution destroys of itself the force of the analogy. Particles of carbonate of lime, when regularly arranged, may obey one law, while, for anything that we know of, the intimate constitution of matter, the same particles, when irregularly congregated, may follow a very different one. Such an analogy might have given rise to conjecture, and might have incited to experiment; but it should surely never have been regarded as justificative of an inference which militates against all experience, and gives white marble so unique a place among solid bodies.

The appeal to direct observation can alone set the matter at rest. Induced by the high importance of the subject, we have made this appeal, and now propose to give an account of the result of our experiments.

The difficulty of making any very accurate measurements of the expansion of bodies by heat is best felt by those who have essayed them. When the rate of expansion of one substance is known, it

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is not a very difficult matter thence to determine the expansibilities of others; the first determination is that which is attended with the greatest difficulty. No substance is free from expansion by heat, so that we can have no permanent standard for measuring the magnitude of that submitted to observation, unless by keeping some slightly expansive material at a fixed temperature. Heat, however, is communicated with such rapidity through even the most slowly conducted media, that either the standard or the variable body changes temperature before the measurements can be effected. Berthoud's plan of lifting a heated bar and placing it upon the plate of a pyrometer, is altogether unfit for accurate purposes, nor is it easy to point out any method that may be entirely free from objections. The heating of the substance, as well as the retaining of it for a considerable time at a fixed temperature, is also attended with inconvenience; in fact, the sources of minute error are so involved, that no observer can be certain of the accuracy of his results, and that it becomes imperative on him to detail all the grounds on which he has proceeded, and all the precautions which he has taken to avoid error.

As we have already hinted, there are two methods according to which we may proceed in determining the expansion of a substance: we may either compare its lengths when differently heated, with that of a body kept at a uniform temperature, or otherwise with those of a body of known expansion subjected to the same changes of temperature. The latter method is attended with comparative facility, and is worthy of the greatest reliance, if the expansibility of the standard substance has been well determined.

The tabulated expansions of few solid bodies can be relied on, on account of the great change in expansion caused by the smallest admixture of any foreign substance. Mercury, from its use in the construction of thermometers and barometers, has been examined with considerable care; yet, among the reported expansions of the fluid metal, there are great differences, mostly to be referred to inaccuracy in the determination of the glass vessels in which it was contained. That account of its variation in which we feel inclined to place the greatest reliance is given by Laylace in his *Systeme de Monde*, where he states it to be 100 parts in 5412, or 18477 in a million, from the temperature of melting ice to that of boiling water.

The rod with which we compared the marble was of glass tube, the rate of whose expansion we determined in the following manner. Of a portion of the tube we formed a vessel with a capillary stem. This vessel we filled with recently distilled mercury, when at the temperature of melting ice: and afterwards subjected it to the heat of boiling water, carefully collecting all the expelled mercury. The weight of the mercury ejected was 66.9 grains, the weight of that remaining in the vessel being 4312.6 grains, giving for the excess of the expansion of mercury above that of glass .015513; whence the expansion of the glass is .002964 in bulk, or 000988 in length.

This result is rather above the expansion usually given in tables, and is liable to a previous error in determining the expansion of mercury. Yet a little reflection will convince any one, that the tendency of most of the errors of observation is to diminish the apparent expansions, so that an increased result seems to afford some proof of the care with which the expansion of mercury has been determined. The chance of error in the weighings was very small, so that, in all probability, the expansion named is very near the truth.

The glass rod was made to serve as beam to a beam-compass, and was subjected to the same change of temperature with two slabs, one of white Carrara, and the other of black or Lucullite marble. At the same time, to afford a check on the process, a wooden beam compass, kept as nearly as possible at one temperature, was likewise compared with the marbles.

In each slab, at the distance of 31.5 inches, were inserted two brass pins, one of which had a minute hole drilled in its centre, for the purpose of receiving one point of the compass, while the face of the other was smoothed to allow of faint

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traces being made on it with the remaining point.

The slabs and the glass compass were placed in a tin trough, and surrounded with broken ice, a sufficient quantity of water being poured in to perfect the communication between the ice and the marble. At the end of an hour, when the marble might be supposed to have attained the temperature of melting ice, a sufficient space was cleared of icy fragments to allow of motion to the glass compass, without raising it above the surface of the surrounding fluid, and faint traces were made with both compasses on the smooth pins in each of the slabs.

The ice and water were then removed from the trough, and their place was supplied with hot water, which was kept boiling at 211° Fahr. for an hour. At the end of that time, traces were again made with each of the compasses, the glass compass having remained completely immersed in the boiling fluid, and the wooden one having been hastily brought from an adjoining apartment, whose temperature had not varied. However, on account of the short but unavoidable delay occasioned by the removal of the upper slab, the wooden beam must have suffered some slight increase of temperature and of length before the trace was made on the pin in the Carrara marble.

The distances between the traces were then examined with a microscope, and measured by means of a silver feather-edge scale, whose markings could be depended on to the 3000th part of an inch.

The total expansions given by the wooden compass were $\frac{33}{3000}$th of an inch for the Lucullite, and $\frac{79}{3000}$th for the Carrara marble, on a length of 31.5 inches, and for a change of temperature from 32° to 211° Fahr.; that is, for the entire change of 180°, an expansion in the black marble of ·000350, and in the white of ·000837.

On examining the traces by the glass compass, it was found that the Lucullite marble had expanded less than had the glass by $\frac{53}{3000}$th of an inch, so that its absolute expansion must be ·000426; while the white marble had lengthened more than the glass had by $\frac{8}{3000}$th; so that its absolute expansion came out ·001072, or two and a quarter times that of the Lucullite marble.

Here it may be noticed, that both of the expansions as given by the glass, are greater than those given by the wooden compass, and that the discrepancy is greatest on the Carrara marble; and we are, therefore, warranted in inferring, that during the time, short as it was, in which the wood was exposed to a moist and heated atmosphere, it had suffered a sensible expansion or twist.

The glass compass having been furnished with two handles, was never removed from the fluid which surrounded the marble; its extreme lightness, when among water, and the shortness of the attached points, removed all risk of the error arising from bending; so that the results obtained by its means seem worthy of dependence, it being kept in mind that they are yet liable to a very small inaccuracy that may exist in the determination of the expansiveness of the glass itself.

The experiments just detailed formed the last of three series, the results of all of which gave very nearly the same expansions. We have given the last, not as made with greater care, but as having had the advantage of additional experience in conducting them. In one of the former experiments, we heated the water by means of two portable furnaces; yet, with all the assistance which two pairs of bellows could give, we were unable to sustain the temperature higher than at 197°. In the last experiment we used seven spirit-lamps, and were not a little surprised when, to restrain the too violent ebullition, we had to remove, successively, four of them, and found that the spirit-lamps kept up a brisk boiling in a trough whose dimensions were 37, 4 and 3½ inches.

The difference between the expansions of black and of white marble is remarkable, considering the small difference which exists between their chemical compositions; but, on inquiry, we found that marble-cutters, aware not only of the expansion of marble in general, but

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of the superior expansiveness of the white varieties, are accustomed to guard against its effects in the construction of chimney-pieces.

In estimating the fitness of any substance for the construction of clock pendulums, other considerations than that of its thermal expansion must be taken. The variable buoyancy of the air, and the changeable resistance which it offers to a moving body, must also be attended to; and it is evident that, in regard to both of these, the dense has the advantage over the rare material. Taking the specific gravity of the marble at 2.7,* it is 2268 times heavier than air; so that a variation of one inch in the barometer will make a change in the length of a beat of the $\frac{1}{2268}$th part, that is, of $\frac{2}{3}$ths of a second per day.

Estimating the expansion of white marble at ·001, each degree of the Fahrenheit thermometer will cause a change in the clocks daily rate of $\frac{1}{4}$ of a second; so that the common deal rod pendulum, with a leaden bob, must, both from its smaller elongation, and from the diminished hydrostatic influence and resistance of the air, be superior to the marble one.

We cannot conclude a paper on the expansion of such bodies, without pointing to the various expansibilities of the materials used in building. It would, indeed, be a useful and an interesting research to inquire into the actions of heat and moisture upon the materials of houses; since, to varieties in these, more perhaps than to chemical decomposition, the gradual dismemberment of edifices may be due. On marbles, the effect of moisture in producing expansion was imperceptible, and from some incidental experiments, the Carrara marble was found to absorb only about the 1800th part of its weight of water. However small the expansions of such bodies may be, they are yet accompanied by enormous force, to prevent the effects of which it is in vain to heap together strength and matter; since just in proportion to the additional strength is increased also the destructive force.

* The white was 2.65, and the black 3.0

VERIFICATION OF OLIVE OIL.

SIR:—In the very able paper read by Mr. Tomlinson on the 2nd instant, great stress was laid on the importance of chemically clean water being employed, the success of these experiments on cohesion figures depending mainly on the absence of any organic deposit which would spoil the surface contact. And I should be led to infer that chemically clean water, by a parity of reasoning, was equally important, but he previously stated that the ordinary water, such as supplied by the New River Company, was sufficiently pure for the purpose. I recollect, some few years since, submitting samples of water from various sources to microscopic test, that of the New River among them, and the result showed minute organic matter in large quantities, especially in those portions taken from the stream near town. I should think it probable that in such a case, on the contact of the drop of oil, there would be a local attraction of such organic matter which would in some way disturb or influence the character of the figure. In an experiment in which so much depends upon the delicacy of manipulation, would it not be better to filter and distil the water so as to ensure its purity as far as possible? I would also beg to suggest to any member who may enter on these experiments, and possess the apparatus, the employment of the oxy-hydrogen microscope—a very high power need not be used. By these means I think a series of experiments might conducted which would result in a definite classification of cohesive figures, which could not fail to be interesting to scientific, and useful to practical society.—I am, &c., MOWBRAY WALKER.—*Society of Arts Journal.*

ANSWER TO CORRESPONDENT.

COUNTRY MEMBER is informed that there is no provision made in the Act for REGISTERING Trade Marks. This deficiency in the Act is referred to in the note to our article in the last Number. What constitutes the Trade Mark is there also set forth, the emblem or cypher, or whatever it is, is printed on a label attached to the production; or, in the case of machinery, an impressed "Trade Mark" is imprinted below. Such a Trade Mark is exhibited in the first page of our present Journal.

NOTICES.

A very well executed Photographic Portrait of Mr. J. F. COLE has just been presented to the Institute Museum, the gift of a few members. Copies may be had of the SECRETARY, 2s. 6d. each.

On Thursday, 26th ultimo, a very full meeting attended to hear the lecture by J. JONES, Esq., V.P., on "Time." This subject, which was treated in a very interesting manner, was adjourned at the wish of the meeting, notice of which appears in another part of this Journal.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., APRIL, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F. and mean sea level	Temperature in the Shade. Dry bulb.	Wet bulb.	Highest	Lowest.	Wind. True Direction.	Force (0 to 12)	Weather. At 9A.M.	During the next 24 hours
	inches.	°	°	°	°				
1	29·702	43	41	52	39	WSW	7	b	cbp
2	·919	42	39·5	50·5	35	W	7	b	c
3	30·002	45	44	53	38	W	2	or	r, c
4	29·878	56	53	56	44	W	3	o	c. rrh
5	30·250	40	39	62	37	NE	3	rh	rr
6	·265	41·5	40·5	41·5	36	SE	2	o	o
7	·310	43·5	42	43·5	40·5	E	2	o	o
8	·406	44	40·5	50	39	SE	1	o	c
9	·306	47·5	45	52	39	WSW	3	o	co
10	·216	55	53	61	47	ENE	2	c	co
11	·112	54	52	60	49	SW	1	o	bc
12	·117	47·5	44	66	43	NE	1	b	b
13	·128	46	43	60	34	E	3	b	b
14	29·992	45·5	42·5	58	36	E	2	b	b
15	·757	48·5	45	59	38	E	2	b	b. or
16	·773	48	47	65	47	N	1	o	r. oc
17	·930	49	47·5	50	42	NNE	2	bc	b
18	30·122	49	46	60	38	W	1	b	b
19	·049	56	51	62	40	S	2	b	b
20	29·990	56	51	68	43	SE	1	bm	b
21	30·043	56	50·5	74	44	E	3	b	b
22	·198	51	48	67	41	E	3	b	b
23	·283	50	47	67	38	E	2	b	b
24	·297	48	45	68	41	E	2	bc	b
25	·214	47	44·5	63	38	E	2	bc	bc
26	·178	50	47·5	61	41	ENE	2	c	cb. pc
27	·221	50	47·5	57	44	E	3	o	c. o
28	·165	45	43	62	43	NNE	2	o	c. o
29	·204	46	44	51	42	N	2	o	bc
30	·167	52	49	67	44	N	3	o	c
	30·106	48·4	45·7	68·9	40·7	—	2·4	—	Mean

REMARKS.

The lowest reading of the Barometer, during the month, was noted a little before 8 a.m. on the 1st, 29·68 inches; and the highest at 10 a.m. on the 8th. 30·42 inches. Hence the range was 0·74 of an inch.

The Wind was strongest on the 1st and 2nd.

There was rain on seven days only, which did not last more than forty-two hours, and amounted to 0·89 of an inch.

The Winds at 9 a.m. may be apportioned as follows:—N. 6; E. 15; S. 3; W. 6.

The month was decidedly fine, with a preponderance of easterly winds, clear weather, steady pressure, and very little rain.

EQUATION OF TIME TABLE.

For May, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *added* to Apparent Time	Difference for One Hour.	At Mean Noon. — Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Wed . .	1	2 25.42	0.383	2 25.40
Thur . .	2	2 16.03	0.400	2 16.01
Fri . . .	3	2 6.23	0.416	2 6.22
Sat . . .	4	1 56.08	0.430	1 56.07
Sun. . .	5	1 45.60	0.444	1 45.59
Mon . .	6	1 34.79	0.457	1 34.78
Tues . .	7	1 23.68	0.468	1 23.67
Wed . .	8	1 12.31	0.479	1 12.30
Thurs .	9	1 0.69	0.489	1 0.68
Fri . . .	10	0 48.84	0.498	0 48.83
Sat . . .	11	0 36.81	0.506	0 36.80
Sun . .	12	0 24.58	0.513	0 24.58
Mon . .	13	0 12.20	0.519	0 12.20
Tues . .	14	0 0.32	0.524	0 0.32
Wed . .	15	0 12.94	0.028	0 12.94
Thurs .	16	0 25.65	0.532	0 25.65
Fri . . .	17	0 38.46	0.535	0 38.45
Sat . . .	18	0 51.30	0.536	0 51.29
Sun . .	19	1 4.17	0.537	1 4.16
Mon . .	20	1 17.06	0.537	1 17.05
Tues . .	21	1 29.95	0.536	1 29.94
Wed . .	22	1 42.81	0.535	1 42.79
Thurs .	23	1 55.61	0.533	1 55.59
Fri . . .	24	2 8.36	0.529	2 8.34
Sat . . .	25	2 21.01	0.525	2 20.99
Sun . .	26	2 33.56	0.520	2 33.54
Mon . .	27	2 45.98	0.515	2 45.96
Tues . .	28	2 58.26	0.508	2 58.23
Wed . .	29	3 10.36	0.500	3 10.33
Thurs .	30	3 22.25	0.491	3 22.22

ADVERTISEMENTS.

	s.	d
Business Advertisements, 4 lines and under..	1	6
Each additional line	0	4
Situations and Apprentices, 2 lines	0	6
Each additional line	0	3

Displayed Advertisements charged for according to the space occupied.

Five per cent. discount on the above charges if three or more insertions are paid for in advance; and ten per cent. on six or more insertions.

N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 23rd of the month.

London: Printed for THE BRITISH HOROLOGICAL INSTITUTE by J. & I. TIREBUCK, Windsor Court, Monkwell Street, E.C.; and Published by KENT & Co., 51, Paternoster Row.

The Journal may also be had at the following Watch Tool Warehouses:—Delolme's, Rathbone-place; Ehnhuus, 53, Frith-street, Soho-square; Grimshaw, 35, Goswell-street; E. Hunt, Ironmonger-row; Muller, King-street, Soho; E. J. Thompson, 5 & 6, Percival-street; Williamson, Frederick-place; Haswell, Spencer-street; C. B. Johnson, Market-place, Prescot, Lancashire; Stevens, Goswell-road; Margetts, "P.O." Goswell-street; and of all Booksellers in Town and Country.

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ANNUAL REPORT OF THE ASTRONOMER ROYAL.

We have to acknowledge the receipt of the Report of the Astronomer Royal to the Board of Visitors at Greenwich Observatory. The following extracts will be found of interest, and especially that relating to the system recommended by Professor Airy for the establishment of time signals at the Start Point near Plymouth. The first public time signal was erected at Greenwich Observatory, and consists of a large ball sliding up and down a mast placed at the top of the building. A few minutes before the understood hour of the signal the ball is raised to the top, and precisely at the time named it is dropped again. This signal was formerly intended for the use of those in charge of marine chronometers on board of ships in the river, enabling them to test the rate, or compare the time shown by them. The universal introduction of voltaic circuits all over the country, in the form of telegraph wires, has rendered it possible to drop a number of these balls simultaneously. One has, therefore, been erected at Deal, also for the use of mariners, and when it drops the instant of Greenwich mean time is indicated to all within view. Still further to extend the plan, and to afford a last means of comparison before leaving the English shores, the Astronomer Royal is endeavouring, as we have stated, to establish a station at the Start Point. The extracts will show the amount of organisation and careful manipulation necessary for the purpose, and also show how thoroughly well considered Professor Airy's plans are. We can only wish, for the sake of the public, that his ideas may very soon be carried out. It may prevent loss of life and property in wrecks as well as detention and consequent loss from defective navigation, caused by the use of instruments not sufficiently compared. W. H.

"*Chronometers, Communication of Time, Longitudes, &c.*—The number of chronometers on hand at the date of this Report is 168; of these, 101 are the property of Government, and 67 are on the Annual Competitive Trial. The whole of the latter and a portion of the former are compared every day with one of the galvanic clocks, sympathetic with the Normal Mean-Time-Clock; the remainder are compared with it once every week. Every Chronometer is tried for some weeks in the heat of the Chronometer Oven.

"All decisions on the merits of chronometers offered to the Government to purchase, and on the merits of chronometers rated in the Annual Competitive Trial, are referred to me; and the repairs of chronometers belonging to the Government are effected entirely through me.

"The system of galvanic clocks (containing among others the Normal Clock, the Chronometer Clock, and the large clock at the Entrance Gate), are all simultaneously adjusted to time by the use, when required, of a galvanic force, which may be kept in action during any arbitrary time, to accelerate or retard the vibrations of the pendulum of the Normal Clock. Another common clock has lately been fitted with contact springs, to enable it to give the currents at every second when the Normal Clock is for a time disabled,

"The Time-Signal-Ball at Deal is dropped daily by a galvanic current automatically given by the Normal Clock; and from the first, very few failures have arisen from defect in the Observatory Apparatus. Failures have usually arisen (and, in the late disturbed state of the South-Eastern Station, more frequently than usual) from defects in the connections of the Railway Telegraph. Time-signals are sent daily to great distances, as Glasgow and Cardiff, and on the principal railways in various directions. Time-signal-guns are fired daily at Newcastle and Shields. The Post-Office Clocks are regulated mechanically, and signals are sent for regulating the Westminster Clock; and all these, as well as the Deal Ball, automatically report to us the success of the effect of the current which left the Greenwich Clock. I shall advert below to the failure

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., APRIL, 1864.

11, Offord Road, N.

Days of the Month.	Barometer, at 32° F. and mean sea level	Temperature in the Shade. Dry bulb.	Wet bulb.	Highest	Lowest.	Wind. True Direction.	Force (0 to 6)	Weather. At 9 A.M.	During the next 24 hours
	inches.	o	o	o	o				
1	29·702	43	41	52	39	WSW	7	b	cbp
2	·919	42	39·5	50·5	35	W	7	b	c
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13	·128	46	43	60	34	E	3	b	b
14	29·992	45·5	42·5	58	36	E	2	b	b
15	·757	48·5	45	59	38	E	2	b	b. or
16	·773	48	47	65	47	E	1	o	r. oc
17	·930	49	47·5	50	42	NNE	2	bc	b
18	30·122	49	46	60	38	W	1	b	b
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20	29·990	56	51	68	43	SE	1	bm	b
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22	·198	51	48	67	41	E	3	b	b
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24	·297	48	45	68	41	E	2	bc	b
25	·214	47	44·5	63	38	E	2	bc	bc
26	·178	50	47·5	61	41	ENE	2	c	cb. po
27	·221	50	47·5	57	44	E	3	o	c. o
28	·165	45	43	62	43	NNE	2	o	c. o
29	·204	46	44	51	42	N	2	o	bc
30	·167	52	49	67	44	N	3	o	c
	30·106	48·4	45·7	68·9	40·7	—	2·4	—	Mean

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The lowest reading of the Barometer, during the month, was noted a little before 8 a.m. on the 1st, 29·68 inches; and the highest at 10 a.m. on the 8th, 30·42 inches. Hence the range was 0·74 of an inch.

The Wind was strongest … 1st and 2nd.

There was rain on … ly, which did not last more th… hours, and amounted to 0·89 of …

The Winds … ioned as follows:—N …

… a pre… weather, …

EQUATI…

Day of the Week.	Day of Mth.
Wed . .	1
Thur . .	2
Fri . . .	3
Sat . . .	4
Sun. . .	5
Mon . .	6
Tues . .	7
Wed . .	8
Thurs .	9
Fri . . .	10
Sat . . .	11
Sun . .	12
Mon . .	13
Tues . .	14
Wed . .	15
Thurs .	16
Fri . . .	17
Sat . . .	18
Sun . .	19
Mon . .	20
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Wed . .	22
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Thurs .	30

…at advantage …ich will here- …publication of …n which I had …will here state …he arrangement …ally decided.

… telegraph wires …n the Admiralty …itehall through …Deptford, towards …dwich, and more …yal Observatory … passing from the …in Deptford called … which one of the … and here, at any …nications of wires … galvanic currents …ll all pass to the … to Gothic House … called "a loop"), …owards Deptford …h.

…n is made at the …nts can be sent …ry to the Admi-

…tford speaking- …alty Telegraph … a wire of the …nent in the …om the Tele- …s continuous, …

Business A… Each addi… Situations … Each addi…

Displa… to the spa… Five p… three or … ten per c… N.B.— … Journal … Office, 3… of the m…

London: … by J. &… and Pu… The Jou… Warch… Frith-… E. Hu… E. J. … erick-… Mark… Marg… Town …

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every day (to remove the error arising from unsteadines of rate; which error the attendant would obtain by observation of the Greenwich signals.) This is best done, as at Greenwich, by fixing on the pendulum a magnet, of which one pole swings above a galvanic coil; a galvanic current, sent at pleasure through the coil, produces attraction or repulsion, according to the nature of the current sent; and the clock is accelerated or retarded. The current must be kept in action till the clock-error is perfectly corrected.

In this manner, it was presumed, accuracy would be insured in the state of the Devonport clock sensibly equal to that of the Greenwich Motor Clock; and thus Devonport might be adopted as basis for the operations by which the Start time-signal would be actually dropped.

For the second section, the arrangements would be the same as those betwen Greenwich and Deal. There must be a clock at the Start, by which the resident at the Start would be guided in order to raise the Start signal at the proper time before each hour; there must be a relay and a local battery; the Devonport Clock, by mechanism similar to that of the Greenwich Motor Clock, must automati-

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of my proposal for hourly time-signals on the Start Point.

In these various operations, about one-fourth of the strength of the Observatory is employed. Viewing the close dependence of Nautical Astronomy upon accurate knowledge of time, there is perhaps no department of the Observatory which answers more completely to the original utilitarian intentions of the founder of the Royal Observatory."

"Before closing this Report, I take the opportunity of placing on record some plans of proposed action, which I am unable to carry out at present; but which, as I trust, with such modifications as experience may suggest, will be adopted for effectual use at some future time. They relate to the system of hourly time-signals proposed for exhibition at the Start Point.

It will be remembered by the Board of Visitors that, after consideration of the reasons which I adduced and the methods of galvanic communication and manipulation which I explained, the Board, at their visitation of 1862, deputed a selection of their members, accompanied by myself, to wait on his Grace the First Lord of the Admiralty, and request his favorable attention to the proposal; and that in the course of the summer of 1862, an answer was received, conveying the substance of communications referring to this proposal which had passed between the Board of Admiralty and the Board of Trade, of which the conclusion was, that the Board of Trade possessed no funds applicable to the defraying of the expenses attending the execution of the scheme. This answer was not laid before the Board of Visitors or known to myself till the visitation of 1863. As it did not fully explain the intentions of the Board of Admiralty, I applied to them in the autumn of 1863, requesting to be informed whether the Admiralty considered as possible the establishment of these time-signals under their own authority; and I received their reply that they do not at present contemplate that measure.

Trusting that the establishment of these signals is only deferred for a few years, and thinking it probable that advantage may result to the system which will hereafter be adopted, from a publication of some details of the plan on which I had proposed to act now, I will here state the general principles of the arrangement on which I had provisionally decided.

The Admiralty possess telegraph wires passing underground from the Admiralty Telegraph Office in Whitehall through the principal street of Deptford, towards Deptford Dockyard, Woolwich, and more distant places. The Royal Observatory possess telegraph wires passing from the Observatory to a house in Deptford called Gothic House, through which one of the Admiralty wires is led; and here, at any moment, such communications of wires can be made, that the galvanic currents from the Admiralty will all pass to the Observatory and back to Gothic House (by what is technically called "a loop"), and thence proceed towards Deptford Dockyard and Woolwich.

When an interruption is made at the Observatory, then currents can be sent direct from the Observatory to the Admiralty Telegraph Office.

The wire of the Deptford speaking-instrument in the Admiralty Telegraph Office can be joined with a wire of the Devonport speaking-instrument in the same office. The wire from the Telegraph Office to Devonport is continuous, and is good, liable only to some interruptions from occasionally receiving the spray of the sea beyond Exeter.

When these connections are made, there is unbroken metallic communication from the Royal Observatory to the Admiralty Office at Devonport; sufficiently good to insure the transmission of Greenwich signals with the regularity required for giving the information by which the Devonport Superintendent can adjust his clock; and also sufficiently good to insure the transmission of automatic signals from the Devonport clock to Greenwich, by which the officers of the Royal Observatory will see the error of the Devonport clock; but not sufficiently good to insure the regular dropping of a time-signal at the Start, if wires should be continued

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from any part of the Devonport telegraph wire to the Start.

The distance, however, from Devonport to the Start is so much less, that it may be expected that no difficulty will be experienced in dropping a time-signal at the Start by the agency of a galvanic battery and automatic clock at Devonport.

The first section then of the proposed operations must consist in such arrangements as will secure the accuracy of a clock at Devonport, and the second section must consist in such arrangements as will secure the accuracy (by automatic action of that clock), of the signal drop at the Start, and will also secure a register at Devonport (by automatic action of the Start mechanism) of the actual success of the signal-drop, in a form which will admit of convenient transmission to the Royal Observatory of Greenwich.

For the first section three arrangements are to be made. (1.) About the time of each of the proposed communications from Greenwich to Devonport or from Devonport to Greenwich (in all, three times or four times every day), for a few minutes at each time, an automatic clock at Greenwich must interrupt the Greenwich loop, and must connect the Greenwich Motor Clock with the Deptford wire to the Admiralty; and an automatic clock at the Admiralty must interrupt the communications of that Deptford wire with its speaking-instrument, and of one Devonport wire with its speaking-instrument, and must connect the Deptford wire with the Devonport wire. (2.) At the times arranged for signals from Greenwich to Devonport, the Motor Clock at Greenwich must for an instant automatically take its wire from earth and connect it with a galvanic battery. (3.) At the times arranged for signals from Devonport to Greenwich, the Devonport Clock must for an instant automatically take its wire from earth and connect it with a battery. All these arrangements are very easy, and their action is practicably infallible.

The Devonport Clock would probably require a small mechanical correction every day (to remove the error arising from unsteadines of rate; which error the attendant would obtain by observation of the Greenwich signals.) This is best done, as at Greenwich, by fixing on the pendulum a magnet, of which one pole swings above a galvanic coil; a galvanic current, sent at pleasure through the coil, produces attraction or repulsion, according to the nature of the current sent; and the clock is accelerated or retarded. The current must be kept in action till the clock-error is perfectly corrected.

In this manner, it was presumed, accuracy would be insured in the state of the Devonport clock sensibly equal to that of the Greenwich Motor Clock; and thus Devonport might be adopted as basis for the operations by which the Start time-signal would be actually dropped.

For the second section, the arrangements would be the same as those betwen Greenwich and Deal. There must be a clock at the Start, by which the resident at the Start would be guided in order to raise the Start signal at the proper time before each hour; there must be a relay and a local battery; the Devonport Clock, by mechanism similar to that of the Greenwich Motor Clock, must automatically send a current accurately at every hour, which will work the relay and put the local battery in connection; and the action of the local battery must withdraw the detent on which the time-signal is lodged, and thus drop the signal; and the signal, shortly before reaching its lowest point, must (by what is called a "tapper-apparatus") so change the connections of the battery that an instantaneous current will be sent to Devonport. These arguments are found, in practice, to work without failure.

It was proposed that the time-signal at the Start should be a skeleton-ball about 8 feet in diameter, dropped through a space of 12 or 16 feet. The locality selected for it is a rock behind the Start lighthouse, called "The Boy." The height of the mast on which it should be raised would be determined after inspection from the sea; but no great height would in any case be necessary. It was proposed

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commence with day signals only: at night signals would be given by a more powerful galvanic communication with the Start, which would enable the galvanic battery to drop a small weight, which would fire a quantity of gunpowder sufficient to produce a flash visible at the Start several miles.

The Devonport record of the currents sent by the tapper-apparatus and the following mechanism was proposed. The Devonport clock was to move a small barrel, perhaps 3 inches in diameter, [illegible] This barrel was to move forward from 1" by a screw of [illegible] part, which would be 60 minute [illegible] a wheel of [illegible] 24 hours, the [illegible] would move 1" each [illegible] the barrel would [illegible] from one end of the barrel to the other in 24 hours. That indicator would impress a point on the barrel by the instantaneous current from the tapper-apparatus. It will be seen that the 24 signals given in the course of one day, if at perfectly uniform intervals, describe on the barrel a spiral very little inclined to the axis. Any departure from uniformity to the extent of 3 seconds of time would immediately be visible to the eye; and this would be sufficient to give confidence on the correctness of management [illegible] At the end of 24 hours the barrel would have performed [illegible] In preparation for [illegible] the indicator would [illegible] the beginning of the [illegible] the indicator would [illegible] second day, [illegible]

[illegible] the paper covering is [illegible] and sent to the [illegible] For the indicator, [illegible] mechanism (suggested [illegible] Professor Wheatstone) in which [illegible] a small cistern of ink is [illegible] with a single hole too small to [illegible] the escape of the fluid ink; the [illegible] the galvanic current thrusts a small wire through this hole, and the end of the wire carries a small film of ink which impresses a dot upon the barrel-paper.

In selecting a course for the telegraph-wires from Devonport to the Start, it was proposed, under the advice of the best telegraph engineers, not to take the shortest line (which would be to return towards London as far as the Kingsbridge Road Station, and then to pass by an inland road directly towards Kingsbridge and the Start Point), but to make use of existing poles to Newtown Junction, Totnes, and Dartmouth, from which [illegible] the extent of telegraph line upon [illegible] would be small.

[illegible] collateral advantages [illegible] the establishment of this [illegible] Accurate time-currents [illegible] Devonport, which could [illegible] to the public exhibition [illegible] either at Mount Wise, or [illegible] column. A communication [illegible] be made of coast [illegible] for military purposes. Facilities [illegible] for a commercial [illegible] the Start Point to Dartmouth [illegible] persons connected [illegible]

G. B. AIRY.

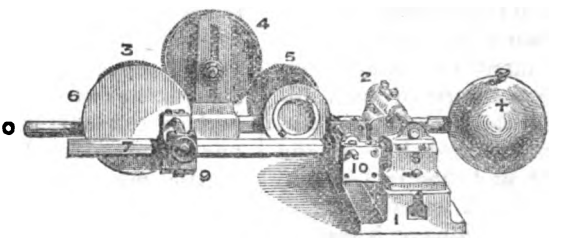
[illegible]

ROBERTS'S [illegible]-DRILL

The [illegible] was the name given [illegible] Richard Roberts, [illegible] instrument we are about [illegible] reasons. And we [illegible] not indicate any [illegible] Wakefield. It would [illegible] to describe what [illegible] would have been [illegible]

Had a better name—a name indicating its use—have called attention to its great capabilities — The caliper engine for instance; for such it is—would long since have become a workshop tool, instead of remaining, as it does, a mechanical curiosity.

The principle of its construction is similar to that of the common sector, being founded on the well-known proportions of the triangle, and is employed in this machine to copy calipers from a large model on to any sized plate less than the pattern.



On a heavy foundation block of cast-iron, having a groove similar in form to that of an ordinary chair for railway bars. A short strong horizontal axis 2 is mounted between two brass blocks, 8, carrying a steel bar 0, of length proportionate to the sort of work intended to be done. This bar projects horizontally over the side of the foundation block, and is balanced by a heavy iron ball, †, on a short counterpoize arm.

This bar is graduated on its upper surface, and carries three slides moving freely along it, and fastening by clamping screws, 3, 4, 5.

No. 3 slide carries a short stout spindle or axis, furnished at one end with a stout gun-metal toothed wheel, and at the other with a chuck to carry the pattern-plate 6. On this pattern-plate is marked and drilled (very carefully) the intended caliper. This slide is fixed by its clamping screw to a particular mark on the bar, and then forms the basis of the graduations before mentioned.

No. 5 slide carries a spindle and toothed wheel, exactly like No. 3, but has a chuck with a ring and screws, or dogs and screws, by which to affix the work; and is fixed when in use at that division on the bar which indicates the desired proportion that the work should bear to the pattern.

No. 4 slide carries a toothed wheel on a stud, the stud moving in a slot, as shown in the drawing, and is capable, by combining the motion along the bar, with the vertical motion up or down the slot, of connecting up the two other cog-wheels, whatever their distance apart, and so insuring coincident motion in both spindles without tooth-shake.

Standing at about 4 inches from, and parallel to, bar 0, a square bar of similar length is securely fixed in the front, carrying block 8 of the main axis, which carries two slides. One of these slides 9 carries a pointed spindle, and is fixed opposite the pattern plate, and is furnished with a spiral spring to keep its point free of the said plate. The other slide 10, carries a drill stock similarly mounted, both standing at such a height from the bar that their points coincide with the centre of the pattern, and work respectively when the two bars stand level.

It will now be seen that the two bars make any angle with each other required, the apex of such angle being the axis of the bar 0. Supposing now a pattern plate, that is, a plate on which a given caliper is marked, say five inches in diameter, be fixed on chuck 6, and the other chuck carrying the plate to which the said caliper is to be transferred, be clamped on the bar at one-third the distance from the centre of motion of the bars, then the distance passed over by the drill point being but one-third that of the pointer, entering the holes in the pattern-plate, while all motions on their own centres, of both work and pattern, are made to coincide by the toothed wheels. The drill will make its mark or hole at a spot corresponding precisely with that on the pattern, and so re-produce the caliper, diminished to one-third the diameter of the original. The same holding good of any other proportion.

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to commence with day signals only; but night signals would be given by a mere change of galvanic communications at the Start, which would enable the galvanic current to drop a small weight, whose fall would fire a quantity of gunpowder sufficient to produce a flash visible at the distance of several miles.

For the Devonport record of the currents sent by the action of the tapper-apparatus at the Start, the following mechanism was proposed: The Devonport clock was to give rotation to a small barrel, perhaps 3 inches long and 3 inches in diameter, covered with paper. This barrel was to revolve in a time differing from 1^h by a small quantity, say by $\frac{1}{720}$ part, which would easily be given by the 60-minute spindle of the clock, carrying a wheel of 30 teeth acting in one of 29 teeth, the latter wheel being fixed to one of 30 teeth acting in the barrel-wheel of 31 teeth. The Devonport clock also was to give slow motion by a screw to the frame carrying an indicator which would be made to travel nearly from one end of the barrel to the other in 24 hours. That indicator would be made to impress a point on the barrel by the instantaneous current from the tapper-apparatus. It will be seen that the 24 signals given in the course of one day, if at perfectly uniform intervals, describe on the barrel a spiral very little inclined to the axis. Any departure from uniformity to the extent of 3 seconds of time would immediately be visible to the eye; and this would be sufficient to give evidence on the correctness of management of the ball. At the end of 24 hours exactly, the barrel would have performed $24+\frac{24}{720}$ revolutions. In preparation for the commencement of a second day, the attendant must draw back the travelling indicator-frame to the beginning of the screw, and then the indicator would, in the course of the second day, describe another spiral at the distance $\frac{24}{720}+$ circumference of barrel from the former. This retraction of the indicator frame is the only daily operation, referring to the register, which is required from the attendant. At the end of each month, the barrel must be removed and replaced by another; the paper covering is then to be taken off and sent to the Astronomer Royal. For the indicator, I proposed to use a mechanism (suggested to me by Professor Wheatstone) in which the bottom of a small cistern of ink is perforated with a single hole too small to permit the escape of the fluid ink; the action of the galvanic current thrusts a small wire through this hole, and the end of the wire carries a small film of ink which impresses a dot upon the barrel-paper.

In selecting a course for the telegraph-wires from Devonport to the Start, it was proposed, under the advice of the best telegraph engineers, not to take the shortest line (which would be to return towards London as far as the Kingsbridge Road Station, and then to pass by an inland road directly towards Kingsbridge and the Start Point), but to make use of existing poles to Newtown Junction, Torquay, and Dartmouth, from which place the extent of telegraph line upon new poles would be small.

The following collateral advantages would attend the establishment of this system of signals. Accurate time-currents would be given at Devonport, which could be made subservient to the public exhibition of time signals, either at Mount Wise, or on the Devonport column. A commencement would be made of coast-telegraph, available for military purposes. Facilities would be given for a commercial telegraph from the Start Point to Dartmouth, much desired by persons connected with the mercantile marine."

G. B. AIRY.

1864, *May* 23.

ROBERTS' NORMAL-DRILL.

The Normal-drill was the name given by the inventor, the late Richard Roberts, Esq., C.E., to the instrument we are about to describe to our readers. And we cannot help thinking, that but for a title that unfortunately does not indicate any connection with watch-work, it would have been unnecessary to describe what we conclude everybody would have been familiar with.

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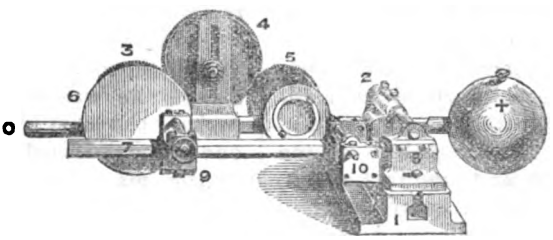
Had a better name—a name indicating its use—have called attention to its great capabilities — The caliper engine for instance; for such it is—would long since have become a workshop tool, instead of remaining, as it does, a mechanical curiosity.

The principle of its construction is similar to that of the common sector, being founded on the well-known proportions of the triangle, and is employed in this machine to copy calipers from a large model on to any sized plate less than the pattern.



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Standing at about 4 inches from, and parallel to, bar 0, a square bar of similar length is securely fixed in the front, carrying block 8 of the main axis, which carries two slides. One of these slides 9 carries a pointed spindle, and is fixed opposite the pattern plate, and is furnished with a spiral spring to keep its point free of the said plate. The other slide 10, carries a drill stock similarly mounted, both standing at such a height from the bar that their points coincide with the centre of the pattern, and work respectively when the two bars stand level.

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THE LATE RICHARD ROBERTS, MECHANICIAN AND ENGINEER.

The following memoir of our late distinguished member, the inventor of the Caliper Engine, is extracted from the *Illustrated London News*, who gave an admirable portrait of this, the most eminent Mechanician of our time.

WE publish a memoir of one of those single-minded servants of science and the useful arts whose fate is, too often, to be poor while making many rich, and whose fame but gilds the memory of such ill-rewarded benefactors of their age. Richard Roberts was born in Denbighshire, on the 22nd of April, 1789, and died in London, on the 11th of March last, in his seventy-fifth year. His extraordinary inventive genius and his skill as a practical engineer contributed, to an incalculable extent, to increase the wealth, not only of England, but of the whole civilised world. Yet he has died in poverty, after a long, a blameless, and a laborious life. An appeal is now made—we will not say to public generosity, but to public justice—on behalf of his only daughter. We may briefly relate his services. He first came to London in 1814, and was employed for a time in the factory of Messrs. Maudslay, then the highest school of mechanical engineering in the kingdom. Three years later, Mr. Roberts, then in business for himself in Manchester, made the first planing-machine for iron, which is still preserved in the Museum of Patents, at South Kensington. His slotting-machine and wheel-cutting engine soon followed; and these, with his improvements in the slide-lathe, may be regarded as among the most important of the aids which invention has given to the construction of machinery. This series of inventions introduced a precision, celerity, and cheapness into that branch of production never before known; their economical results have extended, not only to the largest engines of ocean steam-ships, and to the thousand-handed machinery of the great factories of Lancashire, but down to the railway-ticket press and the sewing-machine. His rare abilities soon led to his being invited to a partnership with the late Mr. Thomas Sharp, with whom Mr. Roberts established the Atlas Works at Manchester, still one of the largest and most productive mechanical engineering factories in the kingdom. Here, in 1825, in consequence of the formidable strikes among the hand-mule spinners of Stalybridge, he was led to the invention of perhaps the most ingenious, as it has been one of the most valuable machines used in textile manufactures. This is the self-acting spinning-mule, requiring only the attention of a child in the production of a thousand threads of an evenness and fineness unattainable by either the handmule or the throstle. Many millions of spindles are now worked upon Mr. Roberts' principle, not only in Lancashire, but in every manufacturing country. Shortly after the opening of the Liverpool and Manchester Railway, Mr. Roberts directed his attention to the improvement of the locomotive engine, and many of his original refinements in its structure and workmanship may still be traced in the railway engines of the present day. Of these engines, it may be observed, nearly 1500 have been constructed at the works where Mr. Roberts completed his first locomotive thirty years ago. One of his most valuable improvements in the manufacture of engines, and all other machinery, but originally applied by him in 1825, to the construction of his spinning-mules, was the application of standard templates to the forms and dimensions of every part. This system, which permits of the exact repetition of every portion of a machine to an endless extent, is that whereby the Enfield rifle is now made under a perfect division of labour; so that any one of a hundred thousand similar parts fits exactly any one of an equal number of corresponding parts. Mr. Roberts received the most tempting offers from the French and Russian Governments to establish himself abroad, but declined, and stayed at Manchester, although he found time to design and put in operation Messrs. Koechlin's large engineering factory at Mulhouse, in Alsace.

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During his long and active career, he applied himself to the invention and introduction of improved turret-clocks, gasmeters, electro-magnets, silk-looms, and many other objects besides those already mentioned. In 1847, at the request of the contractor for the great tubes of the Conway Bridge, Mr. Roberts produced, almost impromptu, one of the most ingenious inventions known in metal-working. This was the "Jacquard punching-machine," an automatic tool of great power, whereby the rivet-holes in a large plate are punched to any required pattern and pitch without need of templates or marking, and with a precision enabling any two of a thousand plates to be riveted together without the subsequent correction of the rivet-holes, which had always before been necessary. Without this invention, the tubes of the Conway Bridge could not have been completed in time; and by it, also, their strength was increased, and their cost of construction cheapened. The same punching-machinery was employed in the construction of the Boyne Viaduct, the Victoria Bridge (the tubes of which are a mile and a quarter long) over the St. Lawrence at Montreal, and the great Jumna Bridge of the East Indian Railway. In 1852 Mr. Roberts designed and made widely known his improved plans for ocean steam-ships of great size, with the improved cross section of bow now adopted by our own and by the French naval authorities. Besides this improvement, he at the same time invented that of the double keels and twin screws, with independent engines, which has now been applied with remarkable success in several steam-vessels of recent construction. An example of the double-screw steamer, which our readers will probably remember is the Atalanta built by Messrs. Dudgeon, of Blackwall. These plans were for some time urged upon the Admiralty, and in 1855 they were submitted by Mr. Roberts, in person, to the Emperor of the French, who examined them critically, and in whose navy some of their peculiarities have been already adopted. In 1852 Mr. Roberts retired from the active pursuit of his profession, although, until within a few days of his death, he continued to practise as a consulting engineer. "His habits and mode of life were marked," say those who knew him personally, "by great simplicity and unceasing industry. A workman himself, he was ever the workmen's true friend. Scientific and other institutions for the benefit of working men, especially in the locality of his early labours found, in him an earnest and liberal supporter. In his character, Mr. Robert's integrity shone conspicuous. He abhorred a lie, and hated dissimulation with a heartiness which could only be best appreciated when he was opposed by the least departure, on the part of others, from what he believed to be the exact truth. His memory of what was essential to truth never faltered, and it has been said of him by Lord Campbell, Lord Brougham, and other eminent Judges, that his answer would be always the same. At one time Mr. Roberts was in comfortable circumstances; but the loss he sustained by the forced sale of his property in Manchester when its value had depreciated in consequence of the difficulties growing out of the stoppage of the American supply of cotton, left him with only his own exertions to depend upon. These he continued almost to the last hour of his long life; and only the day previous to his death, although in a state of extreme weakness, he dictated to his daughter, who had never left his side, a description of some improvements in the sewing-machine, and in machines for cutting slate. Those who knew Mr. Roberts in private life, spoke feelingly of the noble example of filial devotion which his daughter's conduct had presented. Her graces and talents would have easily won for her a different position, but she preferred to sacrifice, not only her prospects, but even her health, as she has done, in order that her father's path to the grave might be smoothed by a daughter's affectionate care. Her case has excited an unusual degree of sympathy, and it is widely felt that the noblest memorial of the father's life and services will be a fitting provision

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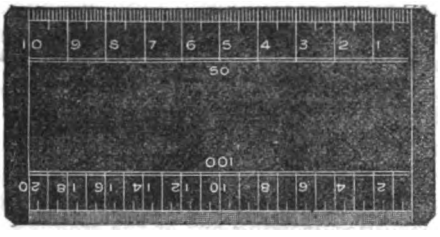
for the daughter." These remarks we have borrowed from a statement, authenticated by the committee formed at an influential meeting, held in the house of the Society of Arts, on the 27th of April, when a resolution, proposed by Mr. William Fairbairn, and seconded by Mr. Bazley, M.P., was unanimously passed to open a public subscription for the object set forth in the last sentence. We observe the Duke of Sutherland, the Earl of Caithness, and Lord Stanley, with many of the best Manchester names, in the list of this committee.

THE INCH DECIMALLY DIVIDED.

TO THE EDITOR OF THE HOROLOGICAL JOURNAL.

SIR,—Below is a sketch of the inch guage sent for the Museum, which may assist, in some degree, the use of a uniform system for guages.



It is extremely simple, is accurate, and easily applicable to any special guage for comparison and verification. It is a two inch guage, divided by an engine affirmed to be accurate to the ·001 (one thousandth of an inch). It is bevelled down on either side, one of which indicates 50ths, and the other 100ths of an inch; and on opaque ivory is easily read off. This little instrument may be well applied to correct ordinary guages, such as those for watch hands which are as nearly as possible divided to 50ths of an inch, (but are arbitrary, and seem to represent nothing definite); for defining diameters of movements, heights of pillars, and correcting any linear guage, which, if brought to conformity, could be universally read off and intelligible.

This might be, if found desirable, supplied by the Institute to its members at a minimum cost—about 2s. 6d.,—and might further the object to which the Institute has devoted considerable time and attention, viz.: to commend the general and systematic use of an uniform system of measurement by standard guages, in this instance by a means within the reach of all.

Where extreme precision is not required, this diagram, fixed upon metal or hard wood, is reliable; the quantities representing tenths of the inch corresponding exactly with the scale, as, indeed, nearly every one of the fine divisions will be found to do.

S. J.

STATISTICS OF THE WATCH TRADE.

The Committee of the Coventry Watchmakers' Association, conceiving that the subjoined abridgement of the Parliamentary paper relating to the Watch Trade, if kept, would prove convenient for reference, have had it (with some introductory remarks which accompanied it) re-printed from the *Coventry Times* for circulation.

Committee-Room, May 12, 1864.

	Gold.	Silver.	Totals.
1850	22,272	93,528½	115,800½
1851	25,509	96,689	122,198
1852	27,871	97,475	125,346
1853	31,307	109,502	140,809
1854	31,249	116,396½	147,645½
1855	29,621	118,492½	148,113½
1856	34,453	128,223½	162,676½
1857	40,542	138,005	178,547
1858	34,263	113,173	147,436
1859	40,338	115,279	155,617
1860	37,588	129,001½	166,589½
1861	35,390	117,165	152,555
1862	34,507	102,246	136,753
1863	36,906	105,714½	142,620½
Totals	461,816	1,580,891	2,042,707

The number of cases marked at each Assay Office.

LONDON	Gold, 318,923	Silver, 1,139,704	1,458,627
BIRMINGHAM	Gold 4,179	Silver, 199,555	203,734
CHESTER	Gold, 138,714	Silver, 241,632	380,345

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BRITISH HOROLOGICAL INSTITUTE.

SIXTH ANNUAL MEETING.

This, the twelfth half-yearly meeting was held at the Institute, 35, Northampton-square, on Wednesday the 22nd June, to receive a report of the state and proceedings of the Institute, the balance sheet showing its financial position; also for the purpose of confirming the election of officers and a Council for the year ensuing. The chair was occupied by Vice-President J. Jones, Esq., F.R.G.S., and among the members present were Mr. Blackie, treasurer, Messrs. Bacon, Browning, Dempster, Evans, Glasgow, Holdstock, Jackson, Lange, Mylne, Palmer, Storer, Strachan, Webb, &c.

The Secretary read the notice convening the meeting.

The minutes and report of the last half-yearly meeting were read and confirmed. The Secretary then read the following report:—

In the absence of any very peculiar circumstances requiring notice, the Council congratulate the members on the steady progress of public opinion in favour of the British Horological Institute. It would, perhaps, be deemed by those having much experience of the early struggles of similar institutions, sufficient cause for congratulation that existence still continues, seeing that years is strength in such cases.

Up to the present time the affairs of the Institute have been managed by honorary officers solely, with the exception of a clerk. The gentlemen who undertook these duties did work that no payment could have compensated; and this applies more especially to the honorary secretaries. Our late honorary secretary, Mr. Hislop, ably, and at a large sacrifice of time, attended to the management of the Institute for more than two years. It was not to be expected that he could continue to do so year after year. At the last general meeting, upon the resignation of that gentleman, it was the unanimous wish of the members that Mr. S. Jackson would undertake the duties of honorary secretary, and, in his absence, he was elected to that post. When the election was made known to him, however, he declined the appointment from his inability to devote the time required. The office of secretary, therefore, became a question of much consideration with your Council. The valuable services of unpaid secretaries is a reliance on which the Council feel that the progress of the Institute cannot reasonably be expected to rest. The difficulty of finding an adequate successor, and the unreasonableness of asking such laborious duties, prompted the Council to seek and appoint a paid secretary, under arrangements which will not increase materially the outgoings of the Institute, and promise improved incomings. This has been done, and, although at a rate of remuneration scarcely commensurate with the extent the Institute promises to attain, will doubtless grow with its growth. Both the necessity and the expediency of the case warranted the Council in adopting the measure now announced.

Among the primary objects of the Institute was the distribution of such knowledge as was in the possession of some, and the offer of incentives to all to advance to further investigation in the art of horology.

With this view a committee of the members has, with the approbation of the Council, (as was explained in the last half-yearly report) raised a fund for the reward of original literary works relating to practical horology, and as a first experiment of this plan, has offered thirty guineas as the prize for a treatise on the detached Lever Escapement and its varieties. In reference to the subscription to this fund, the Council are happy to have to report that £2 was received as a subscription from one of the members, Arthur Trevelyan, Esq., the more encouraging as

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being unsolicited and coming from one whose only interest could be the advance of practical science. The requisite money for the first prize, in this plan of collecting and diffusing knowledge has already, been subscribed, and on the 3rd of September next, at the latest, the Council are justified in hoping that a creditable answer will be given to their challenge.

The Coventry manufacturers, appreciating the policy and the method of our proceedings, have intimated a willingness to co-operate, and possibly merge their own separate efforts with ours into one general scheme. When this first experiment in the Lever Escapement is completed, the committee will address themselves to a second subject, and in the mean time are anxious to receive from all members of the trade such contributions as will support the purposes for which the fund was formed

The importance, as well as the anxieties of property begin to attend the Institute. The stock of the back numbers of the Journal exceeds in value £150 at cost price; nevertheless, customers are waiting for bound volumes which cannot be supplied until some of the earliest numbers are reprinted. For want of funds this cannot be done just yet, and this the Council regret, as the Journal yields a profit.

Means of providing an increased income to carry on the Institute efficiently and keep out of debt altogether, will have to be seriously considered. The Council hope and trust that such alterations in the financial arrangements as they may deem necessary to make during next half year will not only meet with approbation, but with a spirit of pride and determination with the members to make the maintenance of the Institute a point of honour, in the confidence that great future benefit to the horological trades cannot fail to emanate from its influence.

The balance sheet, showing the state of the Institute finances, will fully show all to which the Council desires to draw attention, and cannot fail to satisfy those who know how to wait for the growing harvest.

The laws of the Institute having been revised and amended by a committee appointed agreeably to a resolution of a general meeting of the members, and their recommendations considered and approved by the Council, will to-night be submitted for your approval.

By means of the Journal, Lecture and Discussion Meetings, the Council have endeavoured to make the Institute as useful as possible, and they have reason to believe that their efforts for this object will meet with increased support.

The members, and the horological trades generallly, are indebted to two gentlemen for lectures which have, if we may judge from the numbers by which they were attended, excited much attention. Mr. Strachan on the "Compass;" and Mr. Jones on "Time." These lectures were gratuitous, and exhibited much talent, and would be well if followed by similar aid by other members. The Council refer with satisfaction to a series of original lectures that have from time to time been delivered by the members of the Institute, and hope to be able to announce similar lectures for the coming winter session.

The Council need hardly allude to the great success of the Dinner, both in numbers and amount reached by the subscription in relation to the number that sat down. Certainly, if the members could have known what an enjoyable evening it proved, the number would have been double.

Your Council have finally to draw attention to the fact, that the list of officers proposed for the election, has not been added to by any of the members either in town or country. This circumstance, although flattering to the Council as a strong mark of approbation, has still this small drawback, that, notwithstanding the extremely popular form of election adopted, the half yearly period renders that form very expensive, and when such marked evidence of the possibility of avoiding much of such expense exists, it is almost a matter of regret that any part of the Institute business should be deprived of funds expended to so little purpose in this manner.

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The CHAIRMAN said—It is my duty to propose for your acceptance the report just read, and it is customary to preface such a proposition by a few words. I am sorry to see so few members present. A little time since I was at the Crystal Palace, and met a large body of the watch trade, insomuch that it was quite a demonstration on the part of Clerkenwell; and I should have been pleased if the Council of this Institute had been met this evening by something approaching a similar demonstration. It is true that the cause of benevolence meets with more sympathy than the cause of science, and I do not expect to find that intellectual measures will receive so large an amount of support as those which result from a point of feeling. Our purpose is far higher than the purpose of those who assembled at the Crystal Palace; for whilst we are ready enough to take care of those whom old age and necessitous circumstances have entitled to our regard, we are desirous of assisting those who are labouring in the work which we represent and seek to forward. We live by intellectual progress and seek to forward the interest of the trade by placing before its members the best, the readiest, and most scientific mode of executing the work and gaining public approbation. Under these circumstances, we are not discouraged when we find but few assembling on this occasion. The object of the Institute is one of usefulness, and its Journal gives information with respect to improvements that tend to elevate the trade. After alluding to the Prize Fund and the lectures which have been delivered at the Institute on branches of the science, he proceeded by saying the Institute has existed for no other purpose than that of forwarding science. See what results depend upon a single idea. Where would have been the trade of Switzerland had it not received the horizontal escapement from this country.

After allusions to the further benefits conferred upon the trade by the Institute, the Chairman put the report to the vote, and it was carried unanimously.

The accounts had been prepared by the Finance Committee, but owing to a change in the office of Secretary, they were not ready to be proposed to the meeting for adoption, and it was therefore agreed that the accounts should be received that day three weeks.

The officers, who had been nominated, and whose names appear in another page of this Journal, were then unanimously elected.

The alterations of the laws, and the notice of motion set forth in the Circular, convening the meeting, were not considered owing to there being an insufficient number of members present.

A vote of thanks was presented from the chair to Valentine Knight, Esq., J.P., for his services as the President of the Institute. He had always been found ready when called upon, to devote his time, his money, and his influence in favour of the Institute and of the causes which it promulgated—Carried unanimously.

A vote of thanks was given to the Vice-Presidents, also to the late treasurer, Mr. Blackie, on his resignation of that office, which were responded to.

A vote of thanks was carried to the Council.

A special vote of thanks was offered to Messrs. Jones and Strachan, for the Lectures they had delivered at the Institute during the half-year.

After a vote of thanks had been passed to the *Clerkenwell News*, the thanks of the meeting were presented to the Chairman for his valuable and active usefulness in behalf of the Institute, and the proceedings then terminated.

NOTICE TO MEMBERS.

The Mean-Time Signals sent to the Institute from Greenwich by the Astronomer Royal, which for some time past have been interrupted from causes explained on page 121, are resumed, and may now be expected daily at 2 and 8 p.m.—*British Horological Institute, July 2.*

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., MAY, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F. and mean sea level	Temperature in the Shade. Dry bulb.	Wet bulb.	Highest.	Lowest.	Wind. True Direction.	Force (0 to 12)	Weather. At 9 A.M.	During the next 24 hours
	inches.	°	°	°	°				
1	30·217	51	48	58	46	WNW	4	cb	bc. rr
2	29·848	57	56	65	47·5	W	4	o	o. rr
3	·722	57	54·5	64·5	49·5	W	5	o	c, r
4	·880	49	48	61·5	46	SSE	3	r	o. r
5	·977	49.5	48	49·5	47	S	1	o	o. b
6	·996	50	49	56·5	48	E	2	om	bc. rr
7	·835	52·5	49·5	66	46	N	1	b	c
8	·800	53	50	68	41	E	4	c	o. r
9	·625	48	47	56	45	ENE	3	r	rr. o
10	·937	52·5	49·5	52·5	45	NE	4	o	c. r
11	·914	51·5	50·5	61	46	NE	3	o	c
12	·815	59	56·7	60·5	48	ENE	4	cb	cb
13	30·032	53·5	51	68	46	NNE	2	bc	bc
14	·216	57	54	69	46	N	1	bm	bc
15	·195	64·5	60	74	52	NNW	2	cb	bc
16	·236	63	57	80	51·5	E	1	b	b
17	·248	59.5	57	78	46	E	2	b	b
18	.272	63·5	60	77	53	NE	2	mb	b
19	·264	67	62	81	53	E	1	b	bc
20	·212	66·5	62	79	51	S	1	b	bc. lltr
21	·016	53·5	52·5	78	48	NNW	3	or	o. b
22	·033	60	57·5	62	49	WNW	3	c	bc
23	29.974	58	55	69·5	47	WNW	4	c	bc
24	30.278	52	48	61	40	ENE	4	b	b
25	·081	55	52	62	41	W	4	bc	bc
26	·020	51	47	64	46	NE	5	bc	cb
27	·097	51	47	56	44	N	2	cb	cb
28	·069	53	50·5	63	45·5	N	2	cb	cb
29	29·884	55	52	63	46	WNW	3	o	or. bc
30	30·038	51	47	55	37	SW	2	o	oc. b
31	29·778	55	52	60	42	CALM	0	om	rr
	30·016	55·5	52·6	65·1	46·4	—	2 6	—	Mean

REMARKS.

The greatest barometric pressure observed was 30·295 inches at 10 a.m., 24th; the least, 29·625, at 9 a.m., 9th; hence the extreme range was 0·67 of an inch.

From the 13th to the 20th, the barometric column was above the normal height and remarkably steady, while the temperature of this period was extraordinary for the time of year. A severe thunder storm occurred on the evening of the 20th, after which the temperature decreased very much.

Rain to the amount of 1·98 inches fell on 11 days, during about 57 hours.

The Winds blew in proportion of N. 10; E. 9; S. 4; W. 7, to 1 calm day.

The pressure and temperature have been above the mean values for May, the winds more northerly than usual, and the rainfall deficient.

EQUATION OF TIME TABLE.

For July, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *added* to Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m s.
Fri . . .	1	3 33.92	0.481	3 33.89
Sat . . .	2	3 45.35	0.470	3 45.32
Sun. . .	3	3 56.50	0.458	3 56.47
Mon . .	4	4 7.34	0.445	4 7.31
Tues . .	5	4 17.87	0.431	4 17.84
Wed . .	6	4 28.03	0.416	4 28.00
Thurs .	7	4 37.82	0.400	4 37.79
Fri . . .	8	4 47.23	0.383	4 47.20
Sat . . .	9	4 56.21	0.365	4 56.18
Sun . .	10	5 4.76	0.347	5 4.73
Mon . .	11	5 12.87	0.328	5 12.84
Tues . .	12	5 20.50	0.308	5 20.47
Wed . .	13	5 27.66	0.288	5 27.63
Thurs .	14	5 34.31	0.267	5 34.29
Fri . . .	15	5 40.46	0.246	5 40.44
Sat . . .	16	5 46.10	0.224	5 46.08
Sun . .	17	5 51.21	0.202	5 51.19
Mon . .	18	5 55.78	0.179	5 55.76
Tues . .	19	5 59.80	0.156	5 59.78
Wed . .	20	6 3.28	0.133	6 3.27
Thurs .	21	6 6.20	0.110	6 6.19
Fri . . .	22	6 8.57	0.087	6 8.56
Sat . . .	23	6 10.37	0.063	6 10.36
Sun . .	24	6 11.60	0.040	6 11.60
Mon . .	25	6 12.29	0.017	6 12.29
Tues . .	26	6 12.40	0.007	6 12.40
Wed . .	27	6 11.95	0.031	6 11.95
Thurs .	28	6 10.90	0.056	6 10.91
Fri . . .	29	6 9.28	0.080	6 9.29
Sat . . .	30	6 7.07	0.104	6 7.08
Sun. . .	31	6 4.28	0.129	6 4.29

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N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 23rd of the month.

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A LECTURE ON TIME.

Given at the British Horological Institute on Thursday, May 26th, by J. JONES, Esq., V.P., F.R.G.S., (H. G. WEBB, Esq., in the Chair.)

We have lately made a renewed effort to give influence and action to this Institute. Among the means the periodical setting forth of special subjects, as on this evening, was accounted useful; but the funds for the purchase of such stuff not being at hand I volunteered to do my best in that direction, trusting that others instead of looking around for help will do what they can in investigating such subjects as are relative to our object, and give us the result of their inquiries. The valuable series of lectures given by Mr. Hislop; the masterly discourse by Mr. Strachan the other night; the scientific analysis of the laws of gravitation involved in the pendulum by Mr. Johnson; show what can be done among ourselves: and though I neither expect nor attempt to afford you equal information with what those gentlemen have yielded, yet I can say, as an inducement to others to follow me, that in the reading and scarching necessary to gain an arranged view of my subject, I have found much pleasure, and have often been agreeably surprised at finding fresh accretions of knowledge growing around facts, which I knew before, but which, with this supplementary light, become more interesting and more permanently fixed in my memory.

We are daily engaged in providing instruments which register time, yet I think a good many have not a very clear idea of what that is which their instruments furnish, nor of the mode of ascertaining the standard which is the measure of our results. I do not profess to be an astronomer, and therefore speak not as to those learned in that science, though I trust what I say will not vary from the facts. Time is an abstract idea, and one which the more it is explored the more confusion in understanding it is found; but all people have used the seasons and the revolutions of the moon as the natural standard of time by which to regulate their arrangements with each other when long periods are involved, and the alternation of day and night when shorter periods are dealt with; but though these divisions are so broadly marked in nature, the precise boundaries of each is a difficult problem to prove.

To revert suddenly to the Mosaic period of Egyptian history seems rather to be running away from the subject than discussing it, yet it will be found that in nothing are the services of that ancient period to modern civilization more visible than in the divisions of time. The flat alluvial plains of Egypt and the dry atmostphere must have given to the stars and heavenly bodies a prominence in men's thoughts that our clouded sky does not furnish; and the numerous religious rites of a heathen people became naturally associated with the varying appearances of the sky; from natural as well as professional inclination then the priests of Egypt would carefully observe the signs of the heavens, the revolutions of the moon would recall their monthly festivals, the path of the sun among the stars would in its equinoctial and solstitial points indicate appropriate rejoicings, and the signs of the constellations through which he moved be a convenient method of recording his progress. The supposed influence of the stars over human destiny, a belief prevalent in the East as may be inferred from the passage—"The stars in their courses fought against Sisera," would prompt accurate observations of their rising and falling, all contributory to a school of astronomers whose work remains to this day useful to the world.

The earliest notice of their skill is seen in the arrangements established by one who was learned in all the knowledge of Egypt, as recorded in Exodus xii. 4., for unless one month was distinguishable from another, to point out one as the beginning of the year would have availed little for posterity. The Jews in their religious year still abide by that astronomical institution; in their civil year they date from the conquest of Babylon by Seleucus I., one of Alexander's generals,

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about 300 B.C., who also conquered Syria, whereby the Jews became subject to his authority. They have also an idea that the first month of their religious year was the month of the year in the which the world was created, and in this there is some feasibility, since Moses appointed as the beginning of months, that in which is the first full moon after the vernal equinox, or that point of the heavens where, when the sun is the days and nights are equal, hence called the equator or equaller, which was the time of the passover festival; and in our Easter the rule remains the first Sunday after the first full moon, after the vernal equinox, being Easter Sunday, which regulates all the other festivals of our Church. To know that the days and nights were equal, involves the use of some instrument for measuring hours. I was lately told that in a remote part of India they still use, as a time measurer, a cocoa-nut shell with a very fine hole in it, which is placed in a tub of water, and so gradually fills, an attendant is watching and immediately signals the sinking of the shell, lifts it out of the water and the process is repeated. We see in this the probable prototype of the hour glass, and this may have been in early antiquity the instrument used, for we know that habits in India are permanent. Nor should we neglect another division of time, which the same legislator appointed under divine authority, which has given to modern Europe what ancient Europe had not, a more frequent cessation from labor, viz:—Every seven days, a privilege unknown to workmen under the antient systems, though their labor was as excellent as ours.

The month had a period among the Egyptians of 30 days, and to make the lunar year, or 12 months of 365 days agree with the solar year in a mode moderately sufficient, 5 days were added to the 12th month as intercalary days. In the adoption of 360 days, the period of the lunisolar year, with the correction above-named, one sees the origin of a circle being divided into 360°.

The mode of measuring the altitude of the sun or moon in the heavens, was by the shadows cast on the earth from a gnomon or pillar about 40 ft. high, with a point at the top; its position in respect to the north pole was found by drawing circles from it as a centre, and bisecting the arc between the points of the circle cut by the shadow of the rising and setting sun; the point of bisection gave a meridian line on which future observations might be taken.

The Romans borrowed their religious systems from other nations, and of course imported all their defects. The priests, who were in latter days always ruled by a chief man of the state, Pontifex Maximus, found that their festivals disagreed with the seasons. Vintage, first fruits, harvests were not celebrated when those seasons returned, but according to the calendars of the priests at inappropriate periods. The lambs were grown too large to represent first fruits, the bunches of the vintage were passed away. Julius Cæsar remedied this in his character as Pontifex Maximus when he became Emperor.

Suetonius, a Roman author, under the Emperior Hadrian, in his life of Julius Cæsar, has these words:—"Turning afterwards his thoughts to the regulation of the commonwealth, he corrected the calendar which had for some time become extremely confused through the unwarrantable liberty which the priests had taken in the article of intercalation. To such a length had this abuse proceeded, that neither the holidays designed for the harvest fell in summer, nor those for the vintage in autumn. He accommodated the year to the course of the sun, ordaining that in future it should consist of 365 days without any intercalary month, and that every fourth year an intercalary day should be inserted, that the year might thenceforth commence regularly with the calends or first of January. He inserted two months between November and December."

Augustus followed, and July and August, two months substituted for Quinctilis and Sextilis, remain the memorials of their superintendence of the Calendar.

It was still an Egyptian who gave Cæsar the needful information. There was in the Roman method of dividing the month a peculiarity worth noticing. The first

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days were called Kalendæ, the ninth day before the Ides was called the Nones, every nine days markets were held, the 13th or 15th were called the Ides, (the Ides of March are memorable in history) and then each day was reckoned with reference to the coming Kalenda of the next month, thus six days before the end of the month was called Sextilis, hence from Cæsar's addition of a day in this part of February we have the term Bis-Sextilis or double Sextilis, there being a prior and a posterior Sextilis in the leap year February. It may be worth remarking that our word calendar is borrowed from the Kalendæ, which is borrowed from the Greek word Caleo, I call, from the habit of the priests calling the people to worship at the new moon, similar to the practice in Mahomedan cities of the priests ascending the minarets of the mosque and calling the people to prayers, a custom necessary before bells were introduced into Church steeples.

Though we adopt the motions of the heavenly bodies as our standards, yet much irregularity belongs to them, an irregularity, however, which being known may yield regularity. Meton, an Athenian, 432 years before Christ, had discovered that every nineteen years the moon returned to the same aspect on the same day of the month; he established, therefore, a mode of reckoning which is called the Metonic, which regards nineteen years as a unit. This is the scale which in our Prayer Books you will see named the golden number, and is still in use in the Eastern Church. The Church of Rome has in later days established a new scale of arrangement, for the Metonic is not quite correct, leaving one hour wrong in the nineteen years, compared with the sun's motion.

19		
12	12 moons of alternate	The real length of a month is 29d. 12h. 46m.
228	lengths, 30 and 29	
7	make 354 days.	
235		

Thus in 19 years we have 235 lunations being an excess of 7 lunations to account for the 11¼ days not reckoned in the 12 months, of 365¼ days.

There are minute errors both in the length of the month, reckoning it as 29½ days, in place of 29d. 12h. 46m., and in the length of the year, reckoning at 365¼ days, in place of 365d. 5h. 48m. 48s., which render the Metonic scale slightly inaccurate for long periods.

There are 6932 days in 235 lunations, 6939 days in 19 years.

117½	117½	365¼
29	30	19
1057½	3525	6939
235		
3407½		
3525		
6932		

365¼ days was the period of a year as fixed by Julius Cæsar, but Copernicus, a priest and Polish astronomer, ascertained that 365·5·48·20 was the real length; the difference between these two lengths had in 1,600 years of the Julian period, which reckons from Cæsar's reign, made an error of ten days. When the agitation of Luther had aroused the Church of Rome to a reformation of faith and discipline, many corrections were applied at the Council of Trent, and shortly after, within four or five years after its conclusion, Pope Gregory XIII. again corrected the Calendar, and submitted his alteration to the judgment and acceptance of the various nations of Europe. The immediate cause was the duty of all communicating at Easter, and thus the duty arose of correctly fixing that feast. In 1582 the alteration was made; but in this country, though it was mentioned, no steps reached so reasonable an end. It was the gay Lord Chesterfield, in the reign of George II., who pointed out that different parts of the kingdom began the year at different periods; that France and England had no similarity in their Calendar. That our civil year began in January according to the Roman custom, and that our religious year began in March, he accordingly brought a bill into parliament to alter the Calendar, and the motion was seconded by Earl Macclesfield, whose speech, had I read at first, would have saved me a good deal of work in exploring. It was Dr. Bradley, a contemporary with Newton, by whose advice and knowledge the alteration was made. *Eleven* days were cut out, for since the reformation by the Roman Church, another day of error had crept in. Lord

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Chesterfield's letter on the subject is amusing and somewhat appropriate. We need not be surprised at the Greek Church, prevalent in Russia and Turkey, refusing to acknowledge this amendment, lest it should be indebted to the Pope for anything, when we are told that Dr. Wallis, the mathematician of Oxford, when written to on the subject, remarks that he sees the hand of Joab, that the Duke of Newcastle of that day was surprised at Chesterfield's boldness, and begged him to leave alone such newfangled things; that riots took place in the streets among the lower orders as to the supposed robbery of life, and that Dr. Bradley's illness was regarded as a judgment for his awful impiety. There is a humorous memorial in Hogarth's picture of an election dinner, on one of the banners is written, Give us back our Eleven Days. The Act of Parliament which regulates the alteration from old style to new style is dated 24th George II., (which for threepence can be had of the Queen's printer), and contains a review of the errors it proposes to correct.—King Charles' day and Shakespeare's birthday are nominally right but really wrong.

Thus then I have given some account of the longer periods of time, but the shorter period of a day is what most concerns us, and to that I will next address myself on another evening, premising a few remarks necessary for showing by what means and on what data our time is governed.

HOW TIME IS KEPT.

WE are not going into a deep argument as to the origin or precise nature of our ideas respecting time; but before entering on the subject-matter of this note, we must be allowed to state one or two facts connected with the nature of time, concerning which there appear to be some very erroneous opinions existing in the popular mind; and which we should be glad to be the means of refuting.

The poets and the moralists are, we fear, not altogether free from the imputation of having fostered these sad erroneous views. It is usual, when speaking of the brevity of human life and of things mundane, to say that *time* is short and soon to end, which, although for all practical teaching it comes to the same thing, is in a scientific point of view untrue. We can talk of the death of this life, of the overthrow of a dispensation, or of the destruction of a creation; but were we to entertain for a moment the idea that there would be a cessation of time, it is impossible for us to imagine anything happening after such a catastrophe. No, time never had a beginning nor will it ever have an ending, but all occurrences begin and end in it; and of this fact a few minutes' reflection will assure us.

But we promised not to digress too much in this direction; let us therefore return to the immediate purpose of our note, and attempt to explain to our readers how astronomers

"Correct old Time, and regulate the sun."

The day, that is the interval between two successive returns of the sun to the same meridian, forms the most convenient measure, and all times are but a multiplication or division of this. When we speak of a day, we must be understood to imply a *mean solar day*; but it does not signify whether we obtain this measure from the sun or from the more convenient stars, since intervals of sidereal time are easily convertible by a simple arithmetical operation into intervals of mean solar time. Our measure of time then is a fixed and unalterable thing, and its correctness is capable of being proved on any fine night.

It is evident then that it is part of the duty of the astronomer to tell us when a day begins and when it ends—in fact to tell us what a day is and check our measurements of that period; for our clock is but a machine, and simply serves to show how our day is flying away. Like all machines, it is to be trusted only to a limited extent, and is, moreover, always requiring attention. It would be a matter of no serious moment if all our clocks were wrong by a few seconds, or even minutes; but it would be a very serious thing indeed if such errors were allowed

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to increase to an indefinite amount. Perhaps, reader, you will say that you can set your clock by the rising of the sun: exactly so; but is not this derived from the astronomer? To the sailor, however, who depends on his chronometerin cloudy or foggy weather for weeks together, it becomes a matter of the very greatest importance that he should know that the performance of his time-keeper has been strictly tested by the movements of the heavenly bodies themselves. This comparing and testing of chronometers forms a very important item in the labours of the Government Astronomer. Pages would be occupied in describing the beautiful instruments these chronometers are, and the strict tests they are subjected to before being issued to the Royal Navy; but that would lead to another department of the subject, and at present we confine ourselves to a description of the manner of procuring the time from the heavenly bodies.

The peculiar instrument that is used for determining time, or in more scientific language, with which the *right ascensions* of bodies are observed, is the transit instrument, and may be briefly described as consisting of a telescope supported by its two axes between fixed stone piers, which restrict its motion in any but a vertical plane. At the eye-end of the telescope, and in its principal focus, is placed a frame or wire plate which carries an odd number, generally five or seven, of vertical wires, and two horizontal ones. The observation consists in noting the times at which the object appears to be on each of the vertical wires as it travels across the field of view, between the two horizontal wires: the mean of all the times is then taken. The centre wire should be fixed in the optical axis of the instrument, perpendicular to the pivots of the axis; and, as near as possible, in the plane of the meridian of the place.

Such are the peculiarities of the "transit;" but as modern astronomy has improved upon this, as upon most other of its machines, we shall more minutely describe the more compound kind now in use at the National Observatory, Greenwich. Modern astronomers have combined the simple transit with the *Mural Circle*, an instrument used in measuring the polar distances of stars, &c., and have given to the combination the name of the Transit-Circle. This method possesses many advantages over the old one of observing with the two separately, although there are some, particularly amongst the German astronomers, who contend that stability and that perfect adjustment so necessary in a transit instrument has been sacrificed to convenience in the modern combination. To these objections, however, it only appears necessary to remark, that the transit-circle has been used at Greenwich ever since its first erection in 1850, and has never yet given any but the most perfect satisfaction to the heads of that establishment; whilst its advantages, economy of time and labour among other things, are very great.

Perhaps before looking at the peculiarities of the transit-circle, it would be as well to say something about the clock from which the time is taken when observing transits; an instrument about which there is nearly as much care and attention bestowed in its manufacture and regulation as upon the telescope and its parts.

An astronomical clock, as we have hinted, should be of the very best workmanship, and so constructed that the changes of temperature which it necessarily must encounter shall have little or no effect on its rate. To satisfy this condition the pendulum should be compensated, which is usually done by adopting either the mercurial or gridiron form, the former being that generally used in this country.

The clock is regulated to show sidereal time, so as to keep pace with the heavenly bodies, and indicate their right ascension as they pass the meridian. But with all possible care in construction, every clock will have both an *error* and a *rate*. The *error* of the clock is the amount by which at any moment it differs from the true

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sidereal time; the *rate* is the change of its *error* in twenty-four hours. Although, as is evident, this error should not be large, it does not follow that the magnitude either of that or the rate implies a bad clock; but the rate must be uniform from day to day. When the error amounts to a whole minute the clock is usually set right by moving the minute hand—an operation that is generally not required to be performed on good astronomical time-keepers more than three or four times in the course of a year.

The clock's *error* can of course at once be determined by taking a single transit of a star whose right ascension is known: for example, let the time at which a star is observed to pass the meridian on the 10th of January be 4h. 26m. 52·02s.; the true right ascension of the star is 4h. 27m. 22·86s.; therefore the clock was slow by 30·84s. Let us make a similar observation of the same star on the following day, we find the time on this occasion, as read from our transit clock, to be 4h. 26m. 51·22s, showing the clock to be slow 31·64s, and to have lost eight-tenths of a second during the twenty-four hours. In other words, we learn that the error of our clock is 31·64s, and that it has a *minus*, or losing, rate of 0·80s. per diem.

Let us now return to the telescope: looking into the tube, we perceive a series of fine wires, usually made of spider's web, to the number of thirteen; though, as we have mentioned, in instruments of less importance an inferior number of wires is used. The centre one of these wires is presumed to lie precisely in the line of the meridian: if this were absolutely the case, and the observation correctly taken, only one wire would be needed. As this degree of accuracy, however, is next to impossible to be arrived at in practice, an equal number of wires is used on both sides of the centre one, and the object observed over them all, the mean giving a very accurate reading. For example, let the following represent an observation of a star, at Greenwich, over seven of the wires (three on each side of the meridian wire):—

First wire	14h.	7m.	7·7s.
Second wire	„	7	21·3
Third wire	„	7	34·9
Fourth wire	„	7	48·6
Fifth wire	„	8	2·1
Sixth wire	„	8	15·7
Seventh wire . . .	„	8	29·4
			159·7
Mean = . . .	14h.	7m.	48·53s.

It will be here seen that the numerical mean differs from the observed middle wire by 0·05s, a small amount; but one that would be very largely increased by a less nice disposition of the wires, or by a less experienced observer. Perfection in these respects would be exhibited by the two numbers being exactly equal.

In addition to the vertical wires just described (we are speaking of the Greenwich transit-circle), there is also a horizontal one running across the field of view. This wire is moveable by means of a micrometer head, having divisions engraved upon it, and is used to measure the small parts in polar-distance. On the western axis, and facing the eastern face of the western pier, is the circle on which the polar-distance of the object is read; the other side of the circle being more roughly divided for the purpose of "setting" the instrument. On the other axis is a circle with a flat rim, which is used for "clamping;" that is, for fixing the instrument by means of a clamp and screw in any required position.

The western pier is bored through in six places for admitting microscopes, together with an illuminating apparatus, to be pointed on to the graduated limb of the circle for the purpose of taking the readings of the same. It will be here observed that one reading is not trusted to, but, as in the case of the transit observation, many are taken at different and opposite spots. Were the graduations and form of the circle absolutely perfect, one reading only for each position of the instrument would be sufficient.

We will now, with our readers' permission, imagine the astronomer to have arrived for his night's work; after having

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determined certain adjustments, which it is not necessary to explain, suffice it to say that they are performed before every night's work—occupying about half-an-hour—and that their object is to ascertain that every part of the instrument is in the same state and position as on the previous occasion of its use, the observer begins his work in earnest. As a guide to what he has to do each night, he has by his elbow a list, which is made out afresh at the commencement of every new year. This list contains all the objects that are to form the subjects of each hour's, we might say moment's labour, together with their *north-polar distance* and approximate *right ascensions*, with any other information in the shape of marginal notes that may be deemed desirable. Besides this, he has another list which has been made out that morning in the computing-room; this contains a catalogue of small planets, new discoveries, and any occasional phenomena—such as eclipses, occultations, &c.—that it may be desirable to look after. It will frequently happen that he will find two or more phenomena occurring so nearly together that it is impossible to devote his attention to all; he then will use his judgment in the matter, and decide which would be the most valuable object to take, neglecting those of inferior interest till another opportunity.

The objects which form the special care of the observer with the transit-circle, at the Royal Observatory, are clock stars,—that is stars whose places are very accurately known, and therefore useful in comparing clocks; some circumpolar stars exhibiting proper motion, or that assist to determine the laws of refraction, and any whose places are not accurately noted in existing star-catalogues. The sun, moon, and superior and inferior planets are also most sedulously watched for.

After the adjustments are finished, the shutters in the roof and sides of the transit-room are opened, which allows an uninterrupted view of an arc of the heavens extending from about five degrees above the south horizon to within ten degrees of that of the north. We have already mentioned that the transit-clock shows sidereal time: the observer therefore has only to look on his list to see what objects are, or just about to come, upon the meridian. The clock is so placed that he can both see its dial and hear its beats in whatever position he may be observing. Having selected his object, the astronomer proceeds to "set" the telescope, by the polar-distance circle, at the reading given in his working catalogue, allow a few minutes for refraction if the object be low; and as the clock tells him that the time is approaching when the star should be in his field of view, he applies his eye to the eye-piece of the telescope. If the star should, from imperfect setting, be too far from the horizontal wire, he gently moves the instrument with his hand until it is brought very nearly on the wire, and then by means of the clamping apparatus described above fixes the telescope immoveably in its place.

This done, he commences to take the time from the clock, carrying the seconds "in his head" by hearing the beats, and notes down in his observing book the exact second and fraction of a second at which the star appeared bisected by each wire. And it is surprising how accurately this can be performed by an experienced observer; to do so correctly to about two-tenths of a second being not an unusual degree of exactness.

But this is not all: as we have hinted, there are two elements to be determined with this instrument, and that too by the same person at the same time; as yet we have only seen the star observed in right ascension. Let us see how this is effected: when the star arrives at the middle wire, the observer with his left hand turns the micrometer-head which governs the horizontal wire, bringing it into such a position that the star is apparently split by it. The reading is then taken on the micrometer-head, as are also the readings of all the six microscopes, and the observation is complete in both elements—in right ascension and in north-polar distance.

The electric telegraph and railway trains are the hackneyed symbols under

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which the increased intellectual vigour of the passing century is tritely spoken of—and to the general mind no doubt such giant undertakings offer the most striking example of what human ingenuity coupled with enterprise can effect; but in the more shady walks of science, where the public seldom tread, there are examples that perhaps deserve a higher estimation even than these, as a criterion of that peculiar mechanical refinement (if I may be allowed to invent a term) which seems to be *par excellence*, the distinguished feature of the age. The system of "taking transits" which we have described above has now come to be known as "the ancient method," and in general practice has been entirely discarded in all the principal Observatories of Europe and America. This revolution has been affected through the agency of the electric telegraph. Yes, this marvellous power has created wonders in the limited world of astronomy as well as in the more extended every-day one around us.

It is not our intention to go minutely into the subject of the application of electricity to the practice of astronomy; but simply to put our readers in possession of the main features, in order that they may judge for themselves how vastly superior is the modern over the "ancient" method. Throughout the remainder of this paper we shall take it for granted that our readers have gathered some general ideas of the phenomena of electricity, and the chief characteristics on which its usefulness depends, as an agent for the transmission of, practically, an instantaneous impulse from one place to another. These facts being understood, the following details will be readily appreciated. The chronographic apparatus then, for such is the new method termed, consists of the following arrangement: on the ground floor of one of the instrument-rooms, and divided from the rest of the buildings by the front courtyard, is a clock-movement of a peculiar construction, governed by a pendulum having a conical rotation, which gives to a large brass barrel, connected with the clockwork by a toothed wheel, a very uniform motion. This brass cylinder is covered with a smooth coating of woollen cloth.

When the apparatus is to be used, a sheet of thick paper (manufactured for the purpose), which has previously been thoroughly moistened with water, is folded round the barrel, and its ends securely gummed together. The same clock which drives the barrel also gives motion to two long screws running parallel to its axis; on these screws a a travelling frame traverses—by the revolution of the screws—the length of the barrel. This frame carries two levers, each armed with a pricking-point; so that when one end of the lever is pulled from the barrel the other is pressed down upon the paper, causing a permanent puncture to be left thereon. Behind the levers and opposite to the pricking-points are fixed two galvanic magnets which travel with the frame. Now it is evident that whenever a galvanic current is sent into these magnets, punctures will be impressed upon the paper. But here is a plain sheet of paper, without mark or guide of any kind upon it; we must have some sort of scale upon it, and this is effected in the following manner. One of the prickers is in connection with certain wires that besides a galvanic battery includes the transit-clock in its circuit. A very ingenious contrivance on the escapement causes a prick to be recorded upon the revolving barrel at every second's beat of the clock; an extra mark is made at the even minutes. To prevent the barrel from being used to waste, it is only put "in gear" with the clock-movement just before it is required for recording the observation, and at the same moment and by the same act that connects the barrel the circuit is made complete.

The second pricker is governed by the observer by means of an ivory key, placed near the eye-end of the telescope, which, when pressed with the finger, causes a contact between an insulated pair of brass rings, allowing a galvanic current to pass through the wires to the magnet in connection with the other end of the lever. All that is necessary, therefore, for the observer to do is simply to press this key

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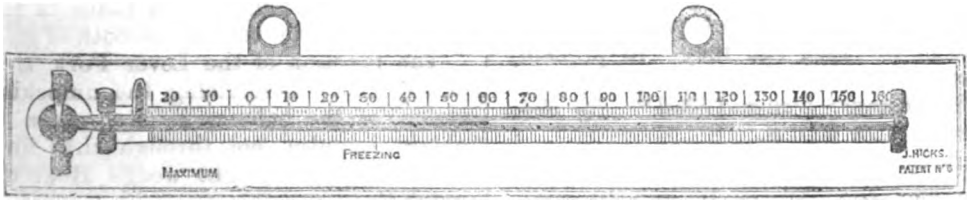
with his hand as the star appears to be on each wire of his instrument, instead of having, as formerly, to estimate from the clock the times of passage. Nearly every observation in which time forms an element of investigation, whether made with the Altazimuth, the Equatorial, or the Transit-circle, is made in the new manner; and the punctured sheets as they are taken off each morning, are carefully dated, the hours, &c., are entered upon them, and the names of the objects that the different groups of pricks represent written in, together with any other information that may be deemed desirable. The next business is to translate these punctures into figures, in order that the ultimate calculations may be proceeded with, and is performed the next morning in the ordinary working hours; one person having in his hand a scale, reads out to another the interpretation of the pricks, whilst he enters them into their proper form. Finally, the sheets themselves are placed in the archives of the Observatory, to be preserved as valuable permanent collections of original observations.

The general reader will doubtless be at a loss to understand why any other than the "ancient" method was necessary, when so great a degree of accuracy could be acquired; those who have any acquaintance with astronomical investigations and with the nicety they demand, will know that, good as the old method was, there was yet something better to be desired, particularly when the observers were not persons of many years' practice. But besides the inaccuracies likely to arise from inexperienced observers, there are some other causes of possible error which defy all remedy. The human eye and ear have, over the most perfect machine that it is possible for the hand of man to construct, certain immense advantages; what those advantages are we need not stop to point out, they will suggest themselves to every reader; and yet these very advantages render them, for some purposes, less suitable than a machine of brass and iron, and astronomical observing is one of those cases. In the course of a night's work, the eye does not see, after an hour's work, as it did at the commencement; the ear and hand are also liable to similar change; the variations in the weather, and the consequent change in the health of the body, all combine to render the human frame unfit for performing this kind of work, night after night, with the precision of machinery.—*From the Electrician for February.*

PATENT MAXIMUM MERCURIAL THERMOMETER.



This invention, patented by Mr. James Hicks, of Hatton Garden, consists in constructing Maximum Thermometers, with a short tube or Mercury Chamber carried from the side of the ordinary Column Tube near the bulb. The bore of this short tube or chamber is larger than that of the column tube, and the action is as follows:—

The Thermometer is set by the bulb end being held downwards to allow the short tube or supplementary chamber to become full, it is then placed in position horizontally, with the short tube or supplementary chamber uppermost. Any increase in temperature will cause the column of mercury to rise in the ordinary Thermometer tube; then upon a decrease in temperature taking place, the column will remain at the maximum, and mercury will descend from the short tube or chamber.—*Mechanics' Magazine.*

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ON THE INUTILITY OF OPPOSING PROGRESS IN THE APPLICATION OF MACHINERY TO TRADE PROCESSES.

Even at the present day attempts at innovation in processes in operation would, in some localities at least, be certain to meet with fierce opposition from the workmen. This will not appear altogether surprising or unnatural when we consider that these men, having by dint of long practice and hard work acquired special skill, which commands a good price in the labour-market, fear that innovations may diminish the value of their services. And doubtless, innovations have, in some instances, occasioned great temporary distress to many industrious and deserving men. Nevertheless, resistance is utterly vain. If improvements are rejected in one locality, they will certainly take root and thrive in another. Numerous examples might be cited, in which, through the obstinate and determined opposition of workmen to all improvements, a thriving manufacture has been annihilated in one town, but only to be transplanted and flourish with greater vigour in another. The moral is that the workman should not hopelessly attempt to retard or check the irresistible law of progress, but should earnestly try to adapt himself to inevitable circumstances. Really intelligent and skilful men will find this to be the most prudent course, and in the long run they will probably have no cause to complain. — *From "Metallurgy: Iron and Steel." By John Percy, M.D. F.R.S.*

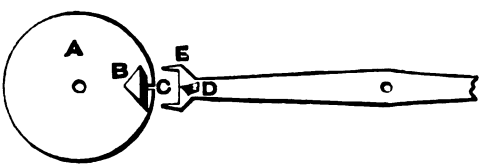
STATISTICS OF THE PRODUCTION OF IRON.

In a recent statement of the present production of Iron by Europe and the United States of America, with the relative per centage of the manufactured material, the writer gives a grand total of 5,817,000 tons. England is stated to produce three millions of tons, with a proportion of the manufactured article represented by 51.6 per cent.

The United States of America produced in 1850, 564,755 tons, of which 278,044 tons were in a manufactured state. In 1810, the production of Iron in that country was not more than 54,000 tons; in 1854 it reached the large sum of one million of tons. France is stated to produce 600,000 tons, with a proportion of the manufactured article of 10.3 per Cent., ranking 3rd and next to the United States for quantity.

In 1810, the entire production of the world in Iron is stated to have been only 740,000 tons.

SOLID IMPULSE LEVER ESCAPEMENT.



The above drawing is on an enlarged scale, and is illustrative of the "Solid Impulse Lever Escapement," referred to by the maker on page 115.

In the specification (registered in 1859) for the improvements claimed in this modification of the 3-pin principle, the acting parts are a steel wedge B, formed from the solid of the lever. The impulse notch C which serves also as the passing notch, as well as the unlocking wedge, or triangular plug B, (in place of the 2 gold pins in the roller,) are both of gold.

The function of the Lever Fork E is chiefly that of receiving the unlocking action of the balance in its return to obtain impulse, not through this fork, but from the upright wedge B at the notch C.

The advantages claimed are chiefly immobility in the delicate action of this escapement; the rate of the watch being less liable to disturbance from casual derangement of the parts, as well as from wear to which the three fine pins of the orginal escapement were very subject.

The impulse wedge D and the un-locking wedge B are now made of ruby, while the notch C is simply filed out of the steel of roller A.

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Subjoined is the statement of receipts and disbursements, prepared by the Members' Auditors; also their statement of assets and liabilities, as moved for at the General Meeting.

The practical obstacle the Council find in accomplishing their desire to extend the usefulness of the Institute is only too palpable from this evidence. Considerably more than one-third of the very modest receipts of the Institute is absorbed in bare house expenses; but for the liberality of those assisting by donations this would amount to one-half of the receipts. It is to be hoped that from the many who are engaged in our occupation, and who wish to see our Society more actively useful, will yet come—that support in purse, and by co-operation, which is alone required to give impulse to an undertaking, the practical labors of which are accomplished by the gratuitous efforts of a few individuals at considerable personal sacrifice. Certainly less than five per cent. of those engaged in Watch making in London alone would out-number all our Subscribers. Need more be said.

ED., H. J.

BRITISH HOROLOGICAL INSTITUTE.

Balance Sheet of Receipts and Expenditure, from December, 1863, to June, 1864.

	£	s.	d.
To balance in hand at last audit .	1	7	2
„ Donations and Subscriptions . .	93	13	0
„ Cash received for Journals . .	5	12	7
„ Ditto ditto Advertisements	9	7	6
„ Rent due from Mr. Palmer . .	5	0	0
„ Cash received for sundries . .	23	10	8
	£138	10	11

	£.	s.	d.
By Rent, Taxes and Insurance . .	21	8	2
„ Salaries, Wages and Commission	38	5	11
„ Printing and Engraving for Journals	30	0	0
„ Stationery, Stamps, &c. . . .	6	12	8
„ Printing and Advertising . .	0	18	3
„ Newspapers and Periodicals . .	2	13	6½
„ Mr. Palmer, care of premises .	5	4	6
„ Sundries 18s., Dinner Account £25. 4s.	26	2	0
„ Cash in hand of Treasurer . .	7	5	10½
	£138	10	11

We have examined the above Account, together with the Vouchers, and found the same to be correct.

JOHN EVANS,
CHARLES BACON,
DENNIS GUNTON, } *Auditors.*

BRITISH HOROLOGICAL INSTITUTE.

JUNE 17th, 1864.

ASSETS.

	£	s.	d.
By House, valuation of fixtures, furniture, &c.	86	9	0
„ Museum Stock	45	9	6
„ Library ditto	32	0	0
„ Journal ditto	126	18	0
„ Subscriptions in arrear . . .	45	4	0
„ Amount due for Advertising and for Journals	18	1	8
„ Ditto „ from Mr. Palmer for sub-letting	5	0	0
„ Cash in Treasurer's hands . .	7	5	10
	£366	8	0½

LIABILITIES.

	£.	s.	d.
To Tirebucks' account for printing Journal	52	7	3
„ Macdonald's ditto . .	11	7	0
„ Lovell and Co., Rent	10	11	0
„ Taxes and House expenses (Taxes £1 5s. 4d., Gas £3 5s., Two tons Coal £1 18s.) .	6	8	4
„ Tirebuck, miscellaneous printing account	3	2	0
„ Harrild, Stationery	1	12	6
„ Miles, Newspapers	2	8	9
„ Dodd, Engraving	3	4	6
„ Clerkenwell News (Advertising)	1	8	9
„ Palmer, care of premises . .	5	4	6
„ Petty cash overdrawn . . .	11	11	3½
„ Balance in favor of Institute .	257	2	2
	£366	8	0½

We have examined the above statement with the entries and found the same to agree.

JOHN EVANS,
CHARLES BACON,
DENNIS GUNTON, } *Auditors.*

NOTICES TO MEMBERS.

Members are informed that the Museum is open, from 7 till 10 p.m., daily.

Notice is hereby given that an adjourned Conversational Meeting will be held at the Institute, on the 3rd Thursday in September, being the 15th, to consider what alteration in the mode of, and rates for stamping Watch Cases can be made for the benefit of the trade. The attendance of manufacturers and case makers is requested, with a view to a full examination of the question.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., JUNE, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F, and mean sea level	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest	Lowest.	True Direction.	Force (0 to 12)	At 9A.M.	During the next 24 hours
	inches.	°	°	°	°				
1	29·824	50	48	59	42·5	NNE	2	o	cb
2	·793	55	52	60	43	NE	1	c	o
3	·873	54	53	63	48	NE	2	r	rr. o
4	·940	55	51	55	44	NE	2	b	bc. b
5	·965	60	55	66	46	W	2	b	bc. or
6	·987	60	56	68	48	SW	3	bc	bc
7	30·002	61·5	58·5	72	48	SW	1	bm	bc
8	29·950	65	62	75·5	52	WSW	2	o	bc
9	·835	61	58	73·5	47·5	WSW	2	cb	bc
10	·922	57·5	54	70	46	W	4	bc	b
11	·881	59	55	71	48	W	4	bc	bc
12	·848	61	57	68	47	SSW	2	c	bc
13	·723	58·5	56	70	49	S	1	om	rr. lt. b
14	·629	62	57·5	64·5	48	SSW	2	bc	c, r
15	·624	55	53	67	48	WSW	3	c	rh. bc
16	·868	59	55	63	45	W	4	bc	bc
17	30.140	63	60	71	48	W	3	o	bc. r
18	·023	62·5	60	72	52	W	5	o	bc
19	.260	61	56·5	70	48	W	5	c	bc
20	·290	60·5	57	67	47	W	4	o	bc
21	·120	61	57	70	50	W	3	c	bc
22	·180	61	58	69	48	W	2	c	c. p. o
23	·000	61	59	67	48	SW	5	o	c. p
24	·207	58	54	66	44·5	W	5	bc	cb
25	·097	61	59	66·5	50	WSW	2	o	c. p.
26	29.954	60	58	69	50	WNW	3	o	c. b
27	30·120	56	52	69.5	44·5	NNW	2	c	o. bc
28	·171	58	54·5	63	46	NW	2	o	c. r
29	·062	62·5	59	66	49	W	2	o	o. r. c
30	29·939	59	56	69	50	W	4	c	c
	29·974	59·3	56·1	67·3	47·5	—	2·8	—	Means

REMARKS.

The standard barometric column measured 30·31 inches at 10 a.m., 20th, and 29·55 inches about 2 a.m., 15th; so that the extreme range of atmostpheric pressure during the month is represented by 0·76 of a linear inch of mercury.

Rain fell on 11 days, during about 46 hours to the amount of 1·51 inches.

The Winds prevailed in proportion of 4 N.; 2 E.; 5 S.; and 19 W.

The temperature was below the normal value for the month, both by day and night, and on no occasion was the high temperature of the previous May reached. The rain, although falling on the average number of days, was half an inch deficient in quantity. The winds were rather more northerly than usual for the month.

EQUATION OF TIME TABLE.

For August, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon — Equation of Time to be *added* to Apparent Time	Difference for One Hour.	At Mean Noon. — Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Mon . .	1	6 0.87	0.154	6 0.89
Tues . .	2	5 56.87	0.179	5 56.89
Wed . .	3	5 52.27	0.205	5 52.29
Thurs .	4	5 47.06	0.230	5 47.08
Fri . . .	5	5 41.25	0.255	5 41.27
Sat . . .	6	5 34.82	0.280	5 34.85
Sun. . .	7	5 27.80	0.305	5 27.83
Mon . .	8	5 20.17	0.330	5 20.20
Tues . .	9	5 11.96	0.355	5 11.99
Wed . .	10	5 3.16	0.379	5 3.19
Thurs .	11	4 53.76	0.403	4 53.79
Fri . . .	12	4 43.80	0.427	4 43.83
Sat . . .	13	4 33.27	0.450	4 33.30
Sun . .	14	4 22.18	0.473	4 22.21
Mon . .	15	4 10.54	0.496	4 10.57
Tues . .	16	3 58.36	0.518	3 58.39
Wed . .	17	3 45.66	0.540	3 45.69
Thurs .	18	3 32.45	0.561	3 32.48
Fri . . .	19	3 18.74	0.581	3 18.77
Sat . . .	20	3 4.57	0.600	3 4.60
Sun . .	21	2 49.95	0.618	2 49.98
Mon . .	22	2 34.90	0.636	2 34.93
Tues . .	23	2 19.42	0.653	2 19.45
Wed . .	24	2 3.55	0.670	2 3.57
Thurs .	25	1 47.26	0.686	1 47.28
Fri . . .	26	1 30.60	0.702	1 30.62
Sat . . .	27	1 13.59	0.717	1 13.60
Sun . .	28	0 56.20	0.731	0 56.21
Mon . .	29	0 38.47	0.745	0 38.48
Tues . .	30	0 20.43	0.759	0 20.43
Wed . .	31	0 2.04	0.772	0 2.04

ADVERTISEMENTS.

	s.	d.
Business Advertisements, 4 lines and under..	1	6
Each additional line	0	4
Situations and Apprentices, 2 lines	0	6
Each additional line	0	3

Displayed Advertisements charged for according to the space occupied.

Five per cent. discount on the above charges if three or more insertions are paid for in advance; and ten per cent. on six or more insertions.

N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 25rd of the month.

London: Printed for THE BRITISH HOROLOGICAL INSTITUTE by J. & I. TIREBUCK, Windsor Court, Monkwell Street, E.C.; and Published by KENT & Co., 51, Paternoster Row.

The Journal may also be had at the following Watch Tool Warehouses:—Delolme's, Rathbone-place; Ehnhuus, 55, Frith-street, Soho-square; Grimshaw, 35, Goswell-street; E. Hunt, Ironmonger-row; Muller, King-street, Soho; E. J. Thompson, 5 & 6, Percival-street; Williamson, Frederick-place; Haswell, Spencer-street; C. B. Johnson, Market-place, Prescot, Lancashire; Stevens, Goswell-road; Margetts, "P.O." Goswell-street; and of all Booksellers in Town and Country.

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THE

HOROLOGICAL JOURNAL:

Special Organ

OF THE

BRITISH HOROLOGICAL INSTITUTE.

VOLUME VII.

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The Horological Journal.

VOLUME VII.

SEPTEMBER 1, 1864.

TO OUR READERS.

The arrival at the completion of another volume of this Publication, offers an occasion to our readers of reviewing the past services of the Journal, and a landing place in the ascent of duties, on which the conductors may beneficially pause to look up with the still ascending staircase of progress, and reckon the constantly increasing severity of the course before them, and their strength for the work.

That an art combining in its products so many and so varied qualifications, should have an organ for intercommunication among its members, is only in keeping with the general habits of the times. There are few trades of any pretensions to importance that do not offer to the printer ground that may be profitably occupied either for the advantage of the enterprising publisher, or for the general benefit of the associated body; in both cases, the condition of the existence of a periodical publication, is the confession of its want, for it could not continue without willing readers. To be equal then, in the arts of civilization, to our brothers in commerce, a periodical Journal seems a necessity, but mere equality with others has not been the leading impulse of those who have devoted themselves to the production of this serial, personal advantage has not prompted their industry, but a genuine desire to promote and assist in the improvement of the most beautiful art which occupies human attention, and to perfect the productions, which aim at nothing less than mathematical precision. Collaterally, doubtless, social advantages result from this literary organization, which are equally shared by every member of the trade, whether a member or not a member of the Institute, whether he assists in the work or not. The mention of such a periodical as being in existence, at once reduces the comparative priority of estimation in which they indulge, whose traffic is in the larger necessaries of human life, and who rely on amounts of money involved in transactions, as the gauge of importance which they assign to the respective sections of society. The knowledge on the part of such men, that watchmakers are associated and mingle their common knowledge into one established journal, at once creates a reflective silence, and a respectful demeanor, and incidentally it may be remarked, that such are some of the conditions of pecuniary success, though this issue is by no means a prominent thought in the minds of those who devote large measures of time at the cost of their ordinary occupation, without recompense to the cause of horology, in the editing of this Journal. There have appeared, it must be acknowledged, a variety of papers in the preceding numbers of great value to the trade which are rather the proper materials of a book, than of a transitory or periodical publication. Such indeed is the confessed

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value that the former volumes have become articles of demand, both at home and abroad, so much so, that reprinting occasional numbers has become necessary to meet the requirements of the market. The publication of the complete series of the whole six volumes, for some time incomplete, owing to No. 3 being out of print, is likely soon to be brought forward and will be duly announced. Every number cannot indeed be equal in force and value, though none are issued without some communication which yields interest to the trade. The stage at which we have now arrived gives promise of increased rather than diminished value. The voluntary contributions which members well-disposed to the publication have given, may still occasionally be given, but as each has parted with some favourite idea, of course, his future assistance is less available. In the change of volunteer contributors, there is hope, however, that this source of supply will not slacken, but in the more labored productions of those who may successfully compete for the prizes offered by the Committee for the best Treatises on Special Sections of the Art, the conductors look for matter which will render the Journal a necessity for all those engaged in the trade who wish for a competent knowledge of the details, equal to the current acquirements of their brother artists. The promised lectures of the coming session will also be reported, and enable those who are away from the lecture-room to keep themselves level with all the ideas promulgated among the members of the trade. The successful organization of the Prize Fund, is an accomplished fact, and the coming month will determine whether a project really practically embodying the purpose of the Institute will be a success. Accepting the hope as a reality, the Institute which now has identified itself in all but finance with the scheme, will pursue its course with a vigour of its own. The coyness of many of the trade to enter its membership will disappear, for however select some may feel, while success is doubtful, all are ready to own relationship with predominant intellect. True, there have been pecuniary difficulties through which the Institute has had to struggle, and none but those who have engaged in the work know how much the members of the several committees have labored to keep the system in efficient order with deficient means. The worst seems past. The Journal is the organ of the Institute, and their prosperity or failure is a joint issue. The printers accounts are in a fair way of liquidation, the future system being based on a large economy. When it is known that successive honorary secretaries, have surrendered large portions of their time during business hours, for months and years continuously, for the maintenance of a cause essentially noble, it is the smallest tribute that men can afford to generous self-devotion to take care that that which has been laboriously founded shall not apathetically fall to the ground. In reference to our art, it is interesting to know that the portrait of the distinguished mechanic, Mr. Thomas Earnshaw, has found a place in the National Gallery of Portraits of those whose minds have advanced the arts of civilization. Mr. E. D. Johnson, with a zeal for the Institute, and the trade, which all must respect, undertook the risk of the cost of engraving the portrait, and thus enables us to possess the likeness of the eminent genius who perfected the detached chronometer escapement. The electric current still supplies the use of the Greenwich Observatory to the trade of Clerkenwell, at the Institute, in the midst of its manufacture; owing to disturbances resulting from Metropolitan Railway Extension, for a period it was suspended, but now again at 2 and 8 P.M. daily, gives Greenwich mean time. The United States Commissioners of Patents have recognized the Institute, so far as to present Six volumes of Patents to the library of the Institute. We need only the steady co-operation of members, with subscriptions, for which the regular supply of the Journal is an acknowledgment, and with their queries or information on all subjects connected with the trade, and to which attentive consideration will be given, no matter from what quarter, to secure an advancing career honorable to the cause of science, creditable to the art of horology, and beneficial to its members.

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LECTURE ON TIME.

(*Concluding portion.*)

Given at the BRITISH HOROLOGICAL INSTITUTE, *on June 30th*, 1864,

By JOHN JONES, Esq., F.R.G.S., Vice-President.

(SAMUEL JACKSON, Esq., in the Chair.)

"It has been my rule, in framing my Reports to the Board of Visitors for several years past, to adapt them to periods bounded at the beginning and at the end either by the beginning or by the middle of a lunation. The Report which I have the honour now to place before the board applies to the period of twelve and-a-half lunations from 1863, May 17, to 1864, May 20." Since last I spoke here on the subject of time, the above report of the Astronomer Royal has appeared, it will now be permitted to me to use a word which formed part of my former observations, and the use of which I then traced to the Egyptians, but since my last lecture it has been used at head quarters. A lunation and more has then elapsed since I endeavoured to explain some of the conditions relating to our division of time into the larger sections of years, months, and weeks. I propose this evening to ask your attention to the division of time, into days and hours. The visible alternations of light and darkness supplies but a rude standard for calculating the hours of labor in city life, and the proportional recompense due to it. While agriculture was the chief engagement, and ministers of religion the chief learned men, time and its divisions into hours was chiefly desirable for the services of the House of Prayer, and an early established service in the Roman church, the "hora," the period for each priest to read prayers for the people, whether the people attended or not, required a time-measurer, but to gauge the instrument, be it hour-glass or water clock, some higher standard was requisite, and astronomy supplied the requisite exactness. The measure of time and the observations of the heavenly bodies act and re-act on one another, each requisite for the other's perfection. The observations of modern astronomy, are marked by extreme exactness, and the instruments employed the most perfect that ingenuity can furnish. It is well to know that the stars are an unchanging picture, displayed on the walls of the concave sphere of the heavens, and that apparently they all revolve around a fixed point, the pole, without relative changes of place. This is noticeable in some measure on any fine night. Some stars rise in the eastern horizon, and ascend the sky and sink again below the western horizon, others near the north pole, may be watched in their progress around the perfect circle so far as the morning light will allow, and a night spent in verifying this, will be the beholding of as grand a pageant as the human mind can contemplate, and as ennobling by contact with the greatness of the universe as any engagement in which we may be involved. That they do keep their respective places, none hurrying before the others may be proved by the equatorial telescope.

You will see these instruments in Mr. Elliott's shop in the Strand, and in Mr. Cooke's, Southampton-street, Strand.

Point the telescope to any star, having fixed it with its axis on the line of the earth's axis, and it will travel with the star in the glass the whole semi-circle. The velocity is regulated by a clock movement, and should be adjusted to the rate of the heaven's progress. Having followed one star one night, another night another star may be traced, and thus the proof given that all move with equal velocity. I said that the picture was unchanging, it is so, though not to our senses, for night after night new stars come to view, till we have gone the course of a year, when the picture is renewed and the panorama repeated. By means of telescopes, when the atmosphere is dry and even, as they say, from deep pits in the earth, stars may be seen in the day light, if then we could see the stars as clearly at day as at night, the picture

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would be what I have called it, unchanging, the varying conditions of light and darkness cause the exception to this fact. There are bodies in the sky, which do not agree with this general law. They are few in number, and are called planets. They are distinguishable by a steadier light, not twinkling, and specially by this quality that they are wanderers in the field of the heavens. That they periodically return to the same position in the heavens has been observed of old, hence the idea of revolution, for their course has early been established, but what form of figure they described or round what body or centre they travelled, has been a mystery from the early ages. Sometimes they were seen on one side the sun, sometimes on the other, sometimes moving, sometimes stationary, and to account for these varied movements, geometrical systems were devised which astonish by the complexity of their contrivance. It could not have been an easy thing to see what we are taught from childhood, that the planetary system revolves round the sun, and the earth has rotation on its axis. Copernicus, a Polish priest, educated at Cracow, whose name I mentioned on a former evening, born in 1473, (one is pleased to find Europe indebted to Poland), was dissatisfied with the very complex arrangement he found existing to account for the motions of the heavens, investigating all ancient records, he concluded that the earth was one of the planetary bodies, and that the whole system of planets revolved round the sun as a centre, while the fixed stars remained in the distant concave, as pictures on the walls of the heavens. The Egyptian astronomer, Ptolemy, had already adopted the theory of the planets Venus and Mercury revolving round the sun, while Mars, Jupiter, Saturn, and the sun revolved round the earth. Apollonius, who lived about 300 years before Christ, one of the finest mathematicians of antiquity, who examined all the properties of the cone and its sections, and these deductions are the standards of our knowledge still, chose the sun as the centre of the planetary bodies, but made that luminary revolve around the earth. The irregularities of the planetary movements were explained by imagining each planet to be contained in a sphere of fluid in which it revolved, thus giving epicycles, as the explanation of variation between theory and observation, both hypotheses made every thing easy in regard to Mercury and Venus, but difficult in regard of the others. Pathagoras had placed a central five as the centre of his solar system, it was a natural step to try whether the conclusion of the sun being the centre, would simplify the computations or agree with the observations. Copernicus found they did sufficiently to recommend this theory to his mind, he published his book, the *Revolutio Orbium*, and dedicated it to the Pope. Within twenty years, he was followed by Tycho Brahe, a Danish philosopher, who made many accurate observations of the positions of the stars, but did not accept Copernicus's theory. He was visited by, and corresponded with Kepler, to whom the world owes the discovery of the elliptical orbits of the planets and the second of his laws that equal areas are performed in equal times. The varying diameter of the sun compared with the curves of his progress gave the idea of the law. The arcs of progress compared with the whole time of revolution, formed one of the elements of the conclusion. It is curious to trace the process of discovery, Pathagoras had adopted numbers as the elementary principles of all things. The 1 was deity; 2, a line contained between two points; 3, a triangle; 4, a square. Such symbolism affected Kepler, he guessed that the being who had constituted these forms must have had some notion of them operating on him in determining the proportions of distance, which the orbits of the planets bore to each other, he inscribed circles inside and outside a triangle, then a square, then a pentagon, and tried whether these proportions suited the facts. The enquiry specially into the movements of Mars resulted in the announcement to the world of elliptical orbits, and the law that the squares of the times of revolution are as the cubes of the distances. Kepler's exultation in discovering the law of equal areas in equal times is worthy of record, "nothing holds me, I will indulge in my sacred fury, I will triumph over mankind by the honest confession that I have stolen

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the golden vases of Egypt to build up a tabernacle for my God far away from the confines of Egypt. If you forgive me, I rejoice; if you are angry, I can bear it. The die is cast. The book is written to be read either now or by posterity, I care not which, it may well wait a century for a reader, as God has waited 6000 years for an observer."

The elliptical orbit more concerns my subject. An ellipse is one of the sections of the cone, explained by Apollonius, it is an oblique section through both, containing sides; a parabola is a section parallel to one of the sides of a cone; a hyperbola a section parallel to the axis. I mention this, since it will be again referred to. The revolution of the earth being admitted as an easy explanation of the phenomena of the heavens, and the elliptical orbit of the earth around the sun being accepted, we proceed to point out the method of standarding time. The fundamental instrument is the transit and mural circle attached to the telescope. The transit is a telescope fixed in such wise that it traverses a line similar to the brass meridian on a globe at right angles to the horizon and intersecting the north-pole, its adjustment is interesting. I was admitted in view of this lecture to the Observatory at Greenwich, and saw that of which a model is in the Kensington Museum. To adjust the instrument the axis is planted level, and the telescope is directed to the polar star. This star is not the pole of the heavens, though very nearly so, it has a small revolution. A clock is at hand, the star passes the field of view, the time is noted whether the top or bottom of the star's course, again the star in twelve hours passes, again the time is noted, and again the third time, the passing of the star is registered by time, if in equal times, the two halves of the circuit are described, the telescope cuts the pole, and is on its traverse a true meridian line. To find the horizon, a star is observed in quicksilver and the point of the mural circle noted, which cuts the fixed pointer, immediately the same star is noted in the sky, and the bisection of the arc of the mural circle between the two readings gives the position of the telescope when it is on the horizon. Then by means of this instrument and a clock, the transit position of every star may be noted. To denote a place on the wall, you want two measures, one so high from the ceiling, so far from the side, thus from the pole is as from the ceiling, and the distance from the wall is measured by time, as we say in walking to a place, it will take you an hour, therefore you judge it is so many miles. A clock is so regulated, that it shows twenty-four hours from the time of a star passing the transit in its field on one day to the same star passing next day. Every hour therefore is fifteen degrees, which again may be divided into proportional parts; by observing then how soon a planet passed after a star, the difference in time would give the arc of the circle in degrees. The starting point for registering observations is in an imaginary line 90 degrees from the pole, called the equator. The particular point in that circle is where the sun cuts the equator in the spring or vernal equinox, and is called the first point of Aries; the curve which the sun describes being known by observation, it is calculable how long a time has elapsed from his crossing the equator to the time of his first meridian transit when nearest to that zero of declination and right ascension, his distance from a star measured in time, gives the distance of that star from the point of zero, which once established, suffices for all future time. Various stars are called clock stars, from their being used as representations of so much time, from the first point of Aries. This sidereal day of twenty-four hours for these clocks are divided into twenty-four hours, is the standard of all other time, and it starts from this first point of Aries. Now, let us observe that the time of the sun, when the sun comes to the meridian is apparent noon, and the time which elapses from one meridian transit to another is called a solar day. The time which elapses from the passage of the sun over the equator to its return in the next spring is a solar year, but the mean solar day is the mean of all the variable lengths of the apparent solar days. The sidereal day is constant. The mean solar day is constant also. This, however, is a question of calculation rather than observation. The point in the heavens, Aries, is the

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starting point of right ascension, the equator of declination. The ratio of the sidereal day to the mean solar day is 23h. 56m. 4s., and a fraction, to 24 hours. There are therefore more sidereal days in a year than mean solar days. I come now to the causes of variation between apparent and mean time. If the earth moved equably in a circle, every day would be equal, supposing that its axis was at right angles to the plane of its orbit, if the earth moved equably in a circle, yet with an inclined axis always parallel, then the obliquity of the axis, would cause variation in length of days, but the earth moves in an ellipse, and with an inclined axis, thus we have two causes of irregularity. The motion of the earth round the sun follows the law of a cannon ball shot from a gun. The velocity is greatest at first, and as the motion is slower the curve is greater. I have read, while Newton was pondering over the laws of motion which govern the heavenly bodies, Dr. Hooke, who gave us the pendulum spring, told him that he had been calculating that the form of a parabola expressed the curve of a projected stone the similarity or relation of the curve of the ellipse, the curve of the heavenly bodies as shown by Kepler, with that of a parabola, the curve of the falling stone suggested to Newton a similarity of cause in both cases, and prepared the way for the publication of the great law of gravitation as the governor of the solar system, as well as the ligament of all terrestrial bodies to the earth's centre, as Galileo in his experiments on the pendulum had shown. The earth is deflected in its direct course by this law of gravitation, accelerated as it approaches the sun in its circuit, and correspondingly retarded as it recedes from it. These changes of velocity result in the illustration of that before named law of Kepler's, that equal areas are described in equal times, which Newton has proved to agree with our laws of motion; it is manifest that as in its oval course the earth has to move through a larger arc of the ellipse at one part of its course, than at another, that a different excess or defect of revolution on its axis will be needed to bring the meridian of any place opposite to the sun, according to what part of the ellipse the earth is moving in, and these differences of excess or defect in the axial revolution of the earth are one of the elements between mean and apparent time.

But the obliquity of the elliptic is another cause of variation. The sun shines over the half the sphere, that point north of the equator which most approaches the sun in the earth's orbit, comes round to the sun earlier than the equator, when the sun is rising in the elliptic and the reverse.

These two causes create the difference between mean and apparent time, and constitute the error, which the equation table has to correct. There is another cause of error, the precession of the equinox. The earth wabbles in its course floating in ether, it is disturbed by the attraction of the moon and planets, instead of being constant in the inclination of its axis at parts of its orbit, it is slowly and periodically disturbed; when in the winter solstice, the sun is nearer to the earth, and has an inclination to draw it from its angle of inclination, making it describe with its axis a circle round the pole, not of great magnitude, yet enough to be taken notice of every year, 50″ is the annual disturbance of axial inclination, which creates the precession of the equinoxes.

I have now given you an account of the earth's variable revolution, of its obliquity, and of the precession of Equinoxes. You will see from them the elements of that error of apparent time, which requires to be adjusted to a mean of 365d. 5h. 48m. 48s. is the period of a solar year, and will know how many elaborate observations and calculations, had to be made before a standard was found for the regulation of the machines, we are employed in making.

The *Nautical Almanac* takes these quantities into account, provides us with a table for every day in the year, by which we may use the sun as our standard for mean solar time.

[A vote of thanks was unanimously passed to Messrs. Elliott, of Charing Cross, and Mr. Betts, of the Strand, for their favours to the Institute, in lending, without charge, the transit instrument, the equatorial telescope, and the globe with which the lecture was illustrated.]

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FRENCH ASSOCIATION FOR THE ADVANCEMENT OF ASTRONOMY AND METEOROLOGY.

This association founded for the purpose of aiding the developement of the studies of Astronomy and of the Physics of the Globe held its first general meeting the third of June, at three o'clock, at the Imperial Observatory.

About 400 members were present; the following gentlemen sat on the committee:—MM. Le Verrier, Dr. Cameau, Glais, Bizoni, Michel Chevalier, Viscount de Vougy, Payen, Belgrand, E. Mouchez, Seret, d'Abbadie, Baron, Barral, Marie Davy, Renou, Sanson, Gaillot and Wolf. The association counts among its members 110 deputies. This powerful co-operation of the Corps Legislatif has ensured the progress of the work at its commencement. Mr. Duruy, in enrolling himself among the members of the association has authorised, agreeably to the request of the director of the observatory, the meetings to take place at that establishment. The president explained the object of the association as follows:—

Astronomy and meteorology are making rapid progress in the old and in the new world, thanks to the aid of the government, individual action, and powerful associations. Numerous establishments are founded, and great works are accomplished under this triple impulse. The French government, more than any other, gives to science a liberal and fruitful support; the towns of Toulouse, Marseilles and Montpellier on their part erect observatories, the Bordeaux Chamber of Commerce founds an annual prize for meteorological observations at sea.

The association for the advancement of astronomy and meteorology has for its object the completion of the means of action in France.

The committee proposes and the association entering into the views which are traced out for it, adopts different resolutions for the progress of astronomy and the physics of the globe.

The imperial observatory possesses two discs of flint and crown glass fit for the construction of a great object glass of * $0^m.75$. It has besides a magnificent glass disc $1^m.25$ in diameter intended for the construction of a telescope mirror.

It is to be hoped that the two great instruments which may be obtained by cutting these glasses, may be commenced without delay and carried out successfully, and it will be suitable to the objects of science to place one of them in one of the towns of the south.

The association has heard with satisfaction that the state is disposed to construct immediately one of these great instruments. The association votes 50,000 francs for the construction of the second instrument, on account of which it is known that a further sum of 70,000 francs will be required to be furnished by the town in which this instrument will be placed.

The commission charged with the first arrangements relative to meteorology, makes the following report:—

REPORT OF THE PRIZE COMMISSION FOR METEOROLOGY.

"The committee of the association for the advancement of Astronomy and Meteorology nominated at its meeting of Monday, 16th of May, a commission charged with the care of preparing the programme for the grand prize for meteorology which has served as a starting point for the foundation of the association itself.

"To fulfil the mission with which it was entrusted, the commission assembled on Friday, 20th May, in the apartments of the meteorological society, under the presidency of M. Belgrand, chief engineer charged with the waterworks of Paris.

"The programme determined upon has been submitted to the deliberations of the committee who adopted it in its meeting of the 23rd May. The committee hope you will sanction its decision.

"Meteorology is one of the most anciently cultivated sciences;—the diversity of climates on the earth's surface, the changes which succeed each other each day in the state of

* Nearly thirty inches.

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the sky, in the amount of agitation, heat and humidity of the air, and especially those great atmospheric perturbations which disturb the surfaces of earth and seas, all these phenomena are too closely connected with our safety and well being not to interest mankind at all times. It belonged, however, to our period, in which science progresses with such rapid strides, and in which resources hitherto unknown are at its disposal, to give to meteorology a fruitful and extensive impulse over the whole surface of the globe, and to combine individual efforts by the rapid communication of results obtained.

"The services rendered to navigation by Maury and by those who have endeavoured to walk in his steps, show that meteorology has entered upon its true career. It can no longer be doubted that, by general research, pursued with perseverance on a scale more and more vast, it will yet attain to a knowledge of the laws yet unknown, which regulate the movements of the atmosphere, and so give us the key to what we call the caprices of the weather. From that day meteorology has rapidly gained ground in public opinion, and your zealous aid bears testimony to the sympathy it has acquired.

"The subjects of study in meteorology are as varied as numerous. Choice between them might appear difficult; the more so as there is always serious inconvenience in enclosing competitors in a too narrow circle. We thus dispel aptitudes from which science might derive great advantage, or call forth, untimely, efforts which might have been more fruitfully applied to another subject.

"The commission however has been struck by the importance of the situation created in meteorology by the initiative of France, by the harmony of all the nations of Europe, and by the zealous aid of the administrations of telegraphs in France and abroad.

"The Imperial Observatory of Paris is now the centre of a great international service of meteorologic telegraphy. Each day seventy despatches make known to the observatory the state of the sky, barometric pressure, and temperature, besides the direction and force of the wind at a similar number of widely separated stations;—in the north as far as Nairn Stromstad, Haparanda and St. Petersburg; to the east as far as Moscow, Kieff, Nicolaëff and Odessa; to the south as far as Constantinople, Palermo and Algiers; to the west as far as Tariffa, Lisbon, and Valentia in Ireland.

"As soon as the observations are received at Paris from these various points, they are used for the construction of a meteorologic chart giving a graphic representation of pressures and winds in Europe. By studying the relations of this situation with those of the preceding days the probable changes of the morrow may be inferred.

"The warnings drawn from this study are sent between noon and one o'clock to the different ports of continental Europe, either directly or through the observatories of the various nations, in order to caution those ports against bad weather which may threaten them.

"An autographed bulletin, containing the meteorological chart for the day, statements of barometer, thermometer, winds, aspect of sky, and sea disturbance, the resumé of the meteorologic situation for the day and the probabilities of the next day, is besides sent the same day by post to the chiefs of the different stations as well as to individuals who wish to follow day by day the variations of weather in Europe.

"An association of this nature is incontestably of great value; its object is most important, that of limiting the number of shipwrecks which cost yearly many thousand lives, and engulf millions.

"The commission thought then it would be advisable to take part in this great enterprise by directing towards it the efforts of the competitors for the prize which you have founded.

"The meteorologic chart of each day is the ground-work which serves as a basis for the probabilities signalised to each port, it is by means of it we try to discover the menace of bad weather which will take place on the coasts of Europe. But in order that this work of deduction may attain a desirable degree of certainty, it is necessary to be more familiarly acquainted with the origin and progress of the storms.

"Without determining too precisely upon a programme, and leaving every latitude to the activity of each person, the commission nevertheless wishes to indicate a tendency in proposing as the subject for the prize of general meteorology, the study of the general movements of the atmosphere.

"The commission however has not stopped there.

"According to generally received opinions, storms which attack our shores come, already formed, from the Atlantic. A considerable collection of observations made on the surface of this vast sea is therefore the necessary base of the work proposed for the principal prize.

"All the movements of the atmosphere are dependent on each other;—a general

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balance is always established between different parts of the globe, therefore materials must be collected from all quarters.

"Besides then the principal prize destined for the best work on the general movements of the atmosphere, the commission awards two series of prizes of less value, the one for observations made at sea, the other for observations made on land at places least known, meteorologically.

"The chief character of the eminently humane work in which the commission has wished you to join is its being an European work, intended to become universal. The commission has respected this character by inviting the co-operation of meteorologists of all nations.

"The programme determined upon, and to which you will give acquiescence, is comprised in the three following articles.

1. "The prize for general meteorology will be awarded to the author of the best work on the *General Movements of the Atmosphere.*

"This prize will be of the value of 4000*f.* (£160.)

"The essays should be as far as possible, written in french. They must be received at the Secretariat of the Society before the 31st December, 1865.

2. "A sum of 1500*f.* (£60.) will be distributed among the authors of the *best observations made at sea.* Each prize of the value of 300*f.* (£12.) may consist partly or wholly, in Instruments. The document for this year should reach the Secretariat before the 31st December, 1864.

3. "A sum of 1500*f.* will be distributed among the authors of the *best series of observations made in parts of the world little known, meteorologically.*

"Each prize of the value of 500*f.* (£20.) may consist, partly or wholly, of instruments. The documents should reach the Secretariat before the 31st December, 1865."

The resolutions of this report are adopted by the association.

Thanks were sent to the Administration of Telegraphs who, for ten years have rendered the most zealous and efficient aid to the organization of the service of international meteorology.

The service of warnings is now being extended to all the coasts of the Baltic Sea, to those of the North Sea, to the French shores of the channel and ocean, to the coasts of Portugal and Spain, to the French coasts of the Mediterranean, to those of Italy, Sicily, the Adriatic as far as Albania, even to the shores of the Black Sea.

The President received and communicated to the assembly a telegram from St. Petersburg;—the great establishment for physics and meteorology in that town congratulates the association. The assembly immediately returned its thanks by the same means.

The committee, wishing that all persons interested in the developement of this scientific movement in our country may form part of the association, has limited the annual subscription to 10*fr.* (8*s.*) But in order that this measure may bear its fruit, it is desirable that *every member enrolled should take on himself the obligation of bringing a new subscriber to whom he will at the same time, make the same request.*

The assembly, considering that the putting into execution of this proposition would powerfully contribute to the success of the society, adopted, as one of the fundamental rules of its constitution, that each member should be obliged to add to the roll a new subscriber.

A great number of ladies taking advantage of the decision to admit them to be enrolled as members of the association, were present at this meeting. France has no need of defending the propriety of an usage which is admitted everywhere else.

The meeting separated after having inspected the observation rooms, and the great instruments in all their details.

Committee meeting of the 20th June, 1864. The association at its general meeting of June 3rd, decided that the obligation of each member to present once for all, another associate should be considered as one of the fundamental rules of the society. The committee will, above all, look to the carrying out of this decision. Each associate will be instantly requested to conform, *in the first month of his enrolment, to a rule of which the strict observance will ensure* the success of the society and of its undertakings.

MM. Elie de Beaumont, de la Rancière le Noury, de Flamarens, General Morin, Delafosse, Ch. St. Claire Deville, Tobert de Lamballe, Peligot, de Col, Delahaye, Fabre, Verdet, Wurtz, Figuier, Gauthier, Villars, de Kerikuff, Landy, Laussedat, Count de Linage, Martin, Phillips, and Lemmonnier, associate members were called to form part of the committee.

The committee decided unanimously that physical works are comprised among those which the association proposes to encourage.

The committee meetings will be held in future the second Monday of each month at half-past eight o'clock precisely. As soon

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as the details of administration, inherent to every first organization, are arranged, and when scientific discussion can take a regular place, the associate members may if they choose be present at the meetings.—*Translated from the "Bulleten International de l'Observatoire de Paris."*—by J. S. HARDING.

WATCH HAND GAUGE,

By DAVID MEEK.

This gauge consists of a disc of brass upon which are engraved concentric circles numbered from 1 to 21, and beyond these the disc is perforated with circular holes of increasing size from 1 to 40. The difference between this instrument and the ordinary hand gauge, in its practicable utility, is that this one affords the means of gauging the pipes of the hour hands, by the perforations around the edge. No sizes for squares appear on this gauge but there is ample room for such.

The inventor says :—

"The large circles radiating from the centre indicate the various lengths both for hour and minute hands, and the small circles round the outside indicate the size of the hour hand sockets.

"As the small circles as well as the large ones correspond exactly with the standard gauge by which the hands are sized, the watchmaker on finding himself short of any particular size of hand has only to refer to the gauge to find the number of the length required; and, if it be the hour hand, to the small circles for the size of sockets, and order accordingly.

"To ascertain the length of any hand by the above gauge it is placed with the socket or square exactly over the centre dot, and the circle to which the point reaches gives the length.

"The hour-hand sockets will be best gauged by taking the size of the hour-wheel socket with the spring callipers, and then measuring what circle corresponds to it. The space within the circle gives the size of hole in the hour hand.

"The advantage to the watchmaker in having a gauge by which to size and order his watch hands, must be very apparent to every one engaged in the trade.

"He will be enabled by it to keep the various sizes separate, and thus save the time usually spent in looking out a particular size of hand from a mixed assortment, and also to see the sizes he is out of, without any trouble.

"It will enable him to order and obtain the exact sizes he requires, and so avoid getting in many sizes not needed, which invariably happens when hands are purchased in the usual way.

"By obtaining only those sizes needed, a better assortment can be kept up at less expense.

"By having even a few hands of each size, considerable time and trouble in fitting will be saved; as in that case a hand is certain to be got that will fit without any trouble, or else very little—the sockets being so finely divided.

"To render the gauge efficient for every purpose, it contains 21 sizes for lengths and 40 sizes for sockets; thus embracing every size of hand needed, from the smallest Geneva, up to the largest English Watch."

60, *North Bridge, Edinburgh.*

ABRIDGEMENTS OF SPECIFICATIONS OF PATENTS

RELATING TO WATCHES, CLOCKS, AND OTHER TIMEKEEPERS.

1854, JUNE 19.—No. 1,335.

WEBER, JOSEPH VALENTIN.—The application of a second or "winding-up" main-spring, so that the main-spring in immediate connection with the going works is maintained at a uniform tension.

[Printed, 6*d.*]

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THE PATENT MUSEUM.

The report of the Commons' Select Committee appointed to inquire as to the most suitable arrangements to be made respecting the Patent-office, library, and museum, has been printed.

The committee directed their attention to the Patent Museum, having regard especially to its formation, its present state, its relation to the Patent-office and library, and the nature of its contents, so as to render it practically useful. The Patent Museum was formed by Mr. Woodcroft, the Superintendent of Specifications, by the request of the Commissioners of Patents, and it consists of models and machines, belonging partly to the Commissioners of Patents, partly to the Commissioners of the Exhibition of 1851, and partly to Mr. Woodcroft himself, and various private persons. This collection has been exhibited since 1857 in the iron building at South Kensington. It occupies a floor space of only 6,700ft., and is too much overcrowded for classification or for due inspection by visitors. The committee are of opinion that the term "Patent Museum," which is generally applied to this collection, tends to give an erroneous impression as to its character and object. Various suggestions have been made by witnesses respecting the nature of a museum connected with the mechanical arts, which may be summed up as follows:—That it should illustrate the history of those arts by a collection of original machines from an early period to the present time; that it should exhibit all known inventions respecting machinery and manufactures; that it should show the present state of all machinery and manufactures. Some of the witnesses suggested that the collection should be restricted to the machinery and manufactures of the United Kingdom, while others proposed that it should be extended to those of foreign countries. Some again proposed that the collection should contain all the objects of each class, while others proposed that a selection only of the most important objects should be exhibited. There was no less diversity of opinion respecting the primary purpose for which any collection or exhibition should be made; some of the witnesses considered that it should be for the purpose of conveying instruction in the mechanical arts, either in a cursory way to people who might visit the museum, or to students in mechanics, or to persons desirous of applying themselves to the discovery of improvements in machinery and manufactures. Other witnesses deemed the museum chiefly desirable for the information of persons intending to take out or purchase patents in aid of the information afforded by books and specifications, to assist them in ascertaining whether the contemplated patent would be valid as a new invention. On the other hand, two witnesses Mr. Carpmael and Mr. Johnson, gave it as their opinion that for all purposes of the patent law a museum of models would be practically useless. The committee are of opinion that any special collection of patented inventions made for the purpose of evidence, illustration, or record of patent rights is not so connected with a general museum of mechanical inventions as to render the neighbourhood of such a museum to a patent-officer and library or law courts necessary. It appears to the committee that the chief purpose of a general museum is to illustrate and explain the commencement, progress, and present positions of the most important branches of mechanical invention; to show the chief steps by which the most remarkable machines have reached their present degree of excellence; to convey interesting and useful information, and to stimulate invention.

In forming an illustrative collection of inventions, it would be necessary to adopt the principle of selection. This, however, does not appear to the committee to be an insuperable objection, especially as no one proposes to substitute models for specifications, which, for all the purposes of administering the patent law, would still have to be consulted, and bear the stamp of authority. Such a collection should contain a selection of models of moderate size which should illustrate different departments of inventions, and also a selection of models of current patented inventions. This collection should be exhibited in connexion with the Patent-office.

Watches and Clocks.—"The number of clocks imported in the first half of this year was 154,170, against 147,154 in the corresponding half of 1863, and 91,731 in the corresponding half of 1862. The number of watches exported to June 30, this year, was 70,324, against 81,738 to the corresponding date of 1863, and 69,856 to the corresponding date of 1862. In June, 1864, there was especially an eager demand for foreign clocks, 40,326 having been imported in that month, against 27,111 in July, 1863, and 22,278 in June, 1862. Considering the great number of clocks and watches manufactured at home, these figures are not a little surprising."—*"Times," 19th Aug.* 1864.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., July, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F. and mean sea level.	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 11.)	At 9A.M.	During the next 24hours.
	Inches.	°	°	°	°				
1	29.950	58	54	69	47.5	W	5	c	c, b
2	.872	62.5	58	66	47.5	WSW	4	bc	cq, r
3	.638	59	56	68	47	W	6	c	rt, oq
4	.993	57	53.5	61	46	W	5	bc	bc
5	30.054	59	55	66	45	NW	4	b	b
6	.156	59	55	71	47	NNE	2	bc	bc, o
7	.169	56.5	55	67	49	NW	2	o	c, b
8	.165	57	53	68	47	NNE	3	bc	c
9	.138	55	52	62	46	N	1	o	o, r
10	.098	61	59	62	49	ENE	3	o	b
11	.095	65	62	76	53	ENE	2	b	b
12	.156	57	55	80	51	NE	4	o	bc
13	050	57	55	74.5	48	NNE	2	o	cb
14	.157	56	54	72	48.5	NNE	2	o	bc
15	.130	61	58	77.5	50	ENE	1	bm	bc
16	.173	61.5	59	76.5	51	SE	1	o	bc
17	.169	62	60	74	50	E	1	cm	bc, p, b
18	.124	66	63	80	53	SE	1	b	bc
19	.107	71	66	75	60	WNW	2	c	bc
20	.108	68.5	63.5	82	58	WNW	2	b	bc
21	29.963	66.5	62	84	57	WNW	2	b	b, r, c
22	.913	64	60	77	53	WSW	2	b	bcp
23	30.016	66	61	71	55	WSW	2	b	bc
24	29.975	64	60	76	54	WSW	2	o	bc, r
25	.846	57	55.5	76	51	WSW	3	r	bc, r
26	.815	64	60	71	54	WNW	3	cb	bc
27	.987	62	58	73	50	W	1	bm	bc
28	.862	64.5	60	74.5	54	SW	4	c	bc
29	30.051	64	60	73	53	W	2	b	bc
30	.197	67	63	77	53	SW	4	c	bc
31	.241	64.5	61	75	57	SW	1	om	bcq
	30.195	61.7	58.2	72.7	51.1	—	2.5	—	Means

Remarks.

The amount of rain was only 0.47 of an inch. The winds were in proportion of 7 N, 6 E, 4 S, to 14 W.

The atmospheric pressure was in excess of its normal value for July, and the rainfall was deficient nearly two and a half inches; while the mean values for temperature and the relative prevalence of the winds agree very closely with the averages of many years. The drought of this summer is very general, and is a subject which should engage the research of meteorologists who have materials at command.

EQUATION OF TIME TABLE

For September, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon. Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At Mean Noon. Equation of Time to be *added* to Mean Time.
		m. s.	s.	m. s.
Thurs .	1	0 16·63	0·784	0 16·63
Fri	2	0 35·59	0·796	0 35·60
Sat	3	0 54·83	0·807	0 54·84
Sun ...	4	1 14·33	0·817	1 14·35
Mon ..	5	1 34·08	0·827	1 34·10
Tues...	6	1 54·04	0·836	1 54·07
Wed ..	7	2 14·23	0·845	2 14·26
Thurs .	8	2 34·60	0·853	2 34·64
Fri	9	2 55·15	0·860	2 55·19
Sat	10	3 15·85	0·866	3 15·90
Sun ...	11	3 36·71	0·872	3 36·76
Mon ..	12	3 57·69	0·877	3 57·75
Tues...	13	4 18·77	0·880	4 18·83
Wed ..	14	4 39·93	0·883	4 40·00
Thurs .	15	5 1·16	0·885	5 1·23
Fri	16	5 22·40	0·885	5 22·48
Sat	17	5 43·66	0·885	5 43·74
Sun ...	18	6 4·89	0·884	6 4·98
Mon ..	19	6 26·07	0·881	6 26·16
Tues...	20	6 47·17	0·877	6 47·27
Wed ..	21	7 8·19	0·873	7 8·29
Thurs .	22	7 29·09	0·868	7 29·20
Fri	23	7 49·85	0·862	7 49·96
Sat	24	8 10·46	0·855	8 10·58
Sun ...	25	8 30·91	0·848	8 31·03
Mon ..	26	8 51·16	0·840	8 51·28
Tues...	27	9 11·19	0·831	9 11·32
Wed ..	28	9 31·01	0·821	9 31·14
Thurs .	29	9 50·57	0·810	9 50·70
Fri	30	10 9·87	0·799	10 10·01
Sat	31	10 28·90		10 29·04

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N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 23rd of the month.

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ON COMPENSATION PENDULUMS.

Compensation Pendulums are those which are constructed to counteract the effect of heat and cold, in lengthening or shortening a pendulum rod.

Godfroi Wendelinus, canon of Condé in Flanders, who published a dissertation, in 1626, on the obliquity of the ecliptic, seems to have been the first who observed that, by change of temperature, metals changed their lengths.

Graham was the first person who thought of making a pendulum rod that should counteract the effects of heat and cold on it, by a combination of rods or wires of different metals, such as brass, silver, steel, &c.; but he never put it in execution, from the opinion that it would not be effectual enough in its operations. It occurred to him at the same time, that mercury, from its great expansion by heat, would be more adapted to the end he was in pursuit of. Having made a pendulum on this principle, it was applied to a clock, and set a-going. It is described in the *Philosophical Transactions*, No. 392, in a paper which was given in to the Society in 1726. He says, "the clock was kept continually going, without having either the pendulum or the hands altered, from the 9th June 1722 to the 14th November 1725, being three years and four months." Some time previous to 1726, Harrison being then at Barrow in Lincolnshire, was engaged in making experiments on brass and steel rods with the same view, and produced what is now called the Gridiron Pendulum. See *Description of two Methods*, &c., by John Ellicott, F.R.S., London, 1753.

Some estimate may be formed of the advantages of a compensation pendulum, by comparing the going of a clock which had one, with that which had a simple pendulum, as shewn in a letter from Mr. Bliss, at Oxford, dated 12th July 1752, to Mr. Short, in London. "I find, upon examining my book, that the greatest difference in the going of the clock, between the coldest weather of the two last winters, and the hottest weather of the two last summers, is no more than one second per day; and this was occasioned by the levers being made too short, of which I advised Mr. Ellicott above a year since: Whereas a clock with a simple pendulum and brass rod, made by Mr. Graham, and which belongs to Dr. Bradley, in the coldest weather lost above fifteen seconds per day, and in the warmest gained above thirteen seconds per day, and went very near the equal time in temperate weather." It is plain that Mr. Bliss must have meant, *gained* in the coldest weather, and *lost* in the hottest, otherwise there would be no analogy with the effect of the temperature in summer and winter on the brass pendulum rod. See Ellicott's pamphlet, already quoted.

Graham's Mercurial Pendulum.—The mercurial pendulum, invented by Graham, having been the first that was applied to a clock for the purpose of compensation, we shall begin with the description of it. This pendulum consists of a pendulum rod, which carries a large glass jar filled with mercury, so that the expansion or contraction of the rod may be counteracted by the opposite expansion or contraction of the mercury. To make this pendulum in the way which has hitherto been adopted, is attended with considerable trouble. From the nature of the material, the construction of such a pendulum must always be troublesome, because any filling in, or taking out of the mercury from the cylinder or glass jar, to bring about the compensation, will cause a change of place in the index point on the graduated arch or index plate, if such a thing is used. A pendulum which will remedy this evil will be afterwards described, so that we shall now proceed to give a description of one made in the common way.

The length of the pendulum over all, from the bottom of the sole to the upper end of the pendulum spring, was 43.95 inches; the inside bottom of the jar, .6 of an inch from the bottom of the sole; and the height of the column of mercury in the

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jar, about 7.47 inches. From the upper end of the spring, take a length of 39.2 inches on the pendulum downwards, then 43.95 inches—39.2+.6, will give that part of the column of mercury below the centre of oscillation equal to 4.15 inches, and that above the centre 3.32 inches. The height of the jar outside, was 7.8 inches; a wire put down inside, measured 7.6 inches; mean diameter inside, 2.018 inches; weight, 7.5 ounces. Although it would be still better to have it of a less weight, yet it is doubtful if it would be then strong enough to support such a column of quicksilver. The weight of the stirrup or cylinder frame was 1 lb. 6 ounces, and was reduced 6 ounces; that is, from the sole was taken 2.55 ounces, and from the top 3.45 ounces, both equal to 6 ounces. When the clock was set agoing after this alteration, with the pendulum the same length as before, it went slow at the rate of 46 seconds in 24 hours, and when shortened by touching up the regulating nut, it was found to be about .15 of an inch less than the former length.

The length of the stirrup bars outside, including sole and part of the top, was 8.125 inches; the breadth of the frame from outside of the bars, 3.25 inches; the thickness of the pendulum rod and bars, 0.136 inch; breadth of ditto, 0.384 inch; thickness of sole outside, 0.515 of an inch; distance from bottom of the sole to upper side of the jar cover, 8.187 inches; jar sunk into the sole about or near to 0.25 inch; distance from upper side of jar cover to under side of stirrup top, 1.25 inch; height of stirrup top for flat of pendulum rod, 1.75 inch; thickness of the flat, 0.220 inch; diameter of the regulating screw, 0.218 inch; ditto of the nut, 1.150 inch. The screw had 36.25 turns in an inch; and the nut was divided into 30 prime divisions, each being equal to a second in a day. The prime divisions were subdivided into four.

	Inches.
Length of stirrup bars inside	8.05
Thickness of sole outside	0.515
Length of stirrup top	1.75
From the stirrup top to the upper end of the pendulum spring....33.485	
Length of the pendulum over all. .43.800	

	Inch.
Length of pendulum spring.....	.625
Breadth of the double laminæ, including .164 the space between them, each lamina being .168 ..	.500
Thickness of ditto	.007

	lb.	oz.	drams.
Weight of quicksilver in the jar	11	12	5.35
Ditto of stirrup frame	1	0	0
Pendulum rod and spring, regulating nut, Jar cover, &c.	0	13	0
Jar	0	7	8
Total weight of Pendulum	14	0	13.35

Before the pendulum was altered, the rate of the clock shewed that the compensation was not sufficiently effective, although the height of the column of mercury was 7.5 inches nearly, and the jar being full, allowed no more to be put in: by reducing the weight of the jar frame or stirrup, the rod required to be shortened, as has been stated, .15 of an inch; whether or not this will be enough, remains to be determined. The daily rate for a month or six weeks was 0″.1 slow, when the temperature was from 36° to 40° of Fahrenheit's thermometer, and got gradually slower as the height of the thermometer increased. When between 60° and 66°, the daily loss was from 0″.37 to 0″.45; for about two weeks, when the weather was extremely cold, the thermometer at the freezing point and under, the clock showed a tendency of rather gaining.

Of late years, the mercurial pendulum has been adopted in some astronomical clocks; and it seems upon the whole to answer very well. The author of the *Elements of Clock and Watch-work*, thought that it was not fit for this purpose, being too quick in its operations of expansion and contraction; but if the cover is well fitted to the top of the jar, we can venture to say, from the resistance made by the glass to any change of temperature, that the operations will be too slow; and for this reason, it is proposed to make such a pendulum with a thicker rod and stirrup bars, that they may not take heat and cold too hastily. A steel jar would perhaps

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answer the end as well as any other contrivance; but some would object to this, on account of the danger of magnetism. But even a jar of this kind, from its being made thin, (for it would be heavy were it as thick as the glass one,) would be easily affected by the changes of temperature; and mercury being still more susceptible of these changes, the operations of counteracting the effects of them might be too sudden.

It is of great importance, that a pendulum rod should, with the smallest quantity of matter, be as stiff and inflexible as possible; and although it was proposed to have thicker bars and rods, let us suppose the same quantity of matter is taken as before, but under a circular in place of a rectangular surface. It must in this form require more time to get heated and cooled, which is the end we now attempt to gain. The sides of the parallelogram were .384 and .136 of an inch, the sum of which being doubled, will give 1.040 inch for the circumference of the bar. To find the diameter of a cylindrical rod containing the same quantity of matter as the parallelogram, say, as 355 is to 113, so is 1.040 to the diameter of the rod required, which will be found to be .33104 of an inch.

Let the improved jar frame, or stirrup, therefore, be composed of two round steel rods, .331 of an inch in diameter, and 8.85 inches in length, from shoulder to shoulder, at each of which pivots are formed. Those for the upper ends should be a quarter of inch long, and of the same diameter, tapped so as to screw firm into the upper cross piece. The distance from the centres of the tapped holes, in the traverse or cross piece, requires to be 2.8 inches, in order to give freedom for the jar between the rods, the length of the crosspiece over all should be 3.3 inches, and its breadth at the place where the rods are screwed in, .450 of an inch. At the middle a circular part is formed, .5 of an inch in diameter, in the centre of which a hole is tapped, by which the regulating screw may raise or lower the jar, without changing the place of the index point, the crosspiece may either be brass or steel, though the latter is perhaps preferable, the pivots on the lower end of the rods may be of the same diameter as those on the upper end, but a little longer, and tapped a little way in on the ends; when well fitted into the lugs of the brass sole, on which the jar rests, and sunk a little way down into it, nuts are screwed on to the ends of the pivots, and sunk in the lower side of the brass sole. Care must be taken to have the distance between the centres of the holes in the sole the same as in the cross piece, so as to make the rods stand parallel to each other. To go outside of the frame now described, another is made, to which is attached the pendulum rod, the regulating nut, and lower sole, in which is fixed the small steel index, which cannot change its place, after being once made for it, the upper cross piece for this may be of the same thickness as the former, and in length not less than 4 inches. A hole is tapped near to each of the ends, and their centres are distant from one another 3.56 inches nearly, and are wide enough to allow a round steel rod of .25 of an inch in diameter to pass freely through; the length of these rods, from the lower side of the cross piece, to the upper side of the lower sole, is nearly 10.6 inches. The lower sole may be a brass wheel, crossed into four arms, the centre part being large enough to have a hole tapped, so as to fix the steel index in it. The diameter of the wheel is the same as the length of the upper cross piece, which is 4 inches; and the thickness .25 of an inch, or a little more. This sole, in which the index is fixed, serves also as a resting part for the pendulum, when it happens to be taken from its place. The upper ends of the rods is formed into a sort of double shouldered screw; the tapped part is a little more than a quarter of an inch long, and as much in diameter; the length of the plain and tapped part of the screw is about .7 of an inch, and when screwed into the upper cross piece, it binds to it the lower end of the pendulum rod, which is formed into a shape something like a compressed λ, having lugs or soles, through which the screws for fixing it passes. The regulating screw has an untapped or plain part, which turns freely in a hole in the middle of this upper cross piece, formed in the same way as

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the upper cross piece for the jar frame; the nut or head of the regulating screw is shaped so as to lie under the hollow of the X, at the lower end of the pendulum rod, and on the upper side of the cross piece; the lower ends of the rods of the outside frame are gently tapered, and fitted into holes in the brass wheel, through the edge of which are put pins to fix them and the wheel together; this outside frame has no part in the compensation, the brass cover for the jar, has the lugs hollowed out a very little, so as to come in on the rods of the jar framed: the ends of the upper traverse, of which, as well as the lugs of the jar sole, are hollowed, and take in with a part of the rods of the outside frame, along which the jar frame is moved up and down, the height of the glass jar outside, is about 8 inches; and its weight and other dimensions nearly the same as those stated for the former pendulum, and the diameter of the rod and X part is .331 of an inch.

Philosophers seem not to be agreed respecting the expansion of mercury relative to that of other metals; some making it 15 times, others above 16 times that of iron. In regard to the column of mercury for a mercurial pendulum, something depends on its diameter as well as its height. Suppose the length of steel to be 43 inches, and the column of mercury 7.5 inches in height, and 2 inches in diameter, which were the dimensions used in a pendulum brought nearly to its state of compensation, we may then find how many times the expansion of this column is contained in the 43 inches. Say, as 43 inches is to 74, the expansive ratio of steel, so is 7.5 inches of mercury, to its expansion for compensating the steel.

Length of steel 43 inches	Log. 1.6334685
Ratio 74	Log. 1.8692317
	3.5027002
Height of column of mercury 7.5 inches	Log. 0.8750613
Ratio 424.26	Log. 2.6276389
	3.5027002

By this process, it appears that the expansion of the mercury is not quite 5.75 times that of the steel. A pendulum, whose vibrations are three or four degrees on each side of the point of rest, will require a column less in height than that which vibrates only one degree. Hence it is a very nice matter to give precise rules for making a mercurial pendulum, that shall at once be perfect in its compensation.

If the steel rod and stirrup of a mercurial pendulum is lengthened by heat, the jar containing the mercury will from this cause, be let lower down, and the centre of oscillation be carried farther from the point of suspension; but the heat which lengthens the rod and stirrup at the same time expands the mercury upward, and by this means the centre of oscillation is kept always at the same distance from the point of suspension. When the rod and stirrup are contracted or shortened by cold, the mercury will also be contracted by it; and hence the lengthening or shortening of the pendulum rod by heat or cold, is compensated by equal and opposite expansions or contractions in the mercury.—*Rees' Cyclopædia.*

RECENT APPLICATIONS OF METEOROLOGY.

The practical applications of meteorologic science, which have resulted from the persevering investigations made during the last quarter of a century, are of such extended and general importance, as to excuse their discussion in the otherwise unoccupied pages of this journal.

The chief among these results are the highly valuable applications (1) of the barometer and of the thermometer for the purpose of measuring great elevations; (2) of the laws of storms to the art of navigation; (3) of storm signals for warning shipping in our parts; (4) of weather

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forecasts for public information and guidance in pursuits depending upon the weather. It would doubtless be saying too much to assert that these applications were unimagined fifteen years ago, but without contradiction they were not recognised as likely to become of any utility, though now they are of practical benefit to mankind. We propose to consider these recent applications of the science.

Applications of Instruments:—The numerous inventions and improvements in meteorological instruments made of late years, more especially since the exhibition of all nations in 1851, have been of incalculable assistance in forwarding the practical objects of the science, as well as in providing better and more accurate numerical data than were generally obtainable theretofore. Numerous registers, replete with observations industriously made during many years, have been found useless in consequence of the imperfection of the instruments used. The waste of labor in the cause of science, on this account, only known to a few, to those only who have had to consult such documents largely, is quite lamentable. It may now be said emphatically that it is the meteorologists own fault if his instruments are not as perfect as art can make them, there being observatories where they can be verified, and easy means of checking their indications, while the makers recognise the scientific importance of their work, and value their reputation too much to offer for sale instruments that are not tolerably correct. The applications of instruments as weather-glasses, such as barometers, aneroids or sympiesometers, thermometers, hygrometers and rain-gauges, are now so well recognised that they are used extensively as guides to the weather, without registration for statistical returns, by almost all who can afford to possess them. Careful mariners never think of putting to sea without them, and farmers are rapidly learning their value.

The formulæ for barometer scales devised by Admiral Fitz Roy, which enunciate the interdependence of the wind's direction and strength with relative humidity, and the alterations of pressure and temperature, as developed by the labours of Kaemtz, Dové, Herschel and others, are so concise, so admirably suited for the purpose, being unfettered by geographical limits, or elevation above the sea, which rendered the formulary on old barometers as to fine, rainy, &c., absurb, even if it were suitable on any other account, that they have been a boon to the science, and have done much to extend the practical use of the barometer. Nothing less than great experience in the practical use of weather instruments in different parts of the world, together with a thorough acquaintance with the works of the great writers in meteorology, could have enabled any one to have framed these simple and useful rules.

Admiral Fitz Roy's words for the scales of barometers for use in northern latitudes, then, are as follows:—

RISE.	*FALL.*
FOR	FOR
N. ELY.	S. WLY.
NW.--N.--E.	SE.--S.--W.
DRY	WET
OR	OR
LESS	MORE
WIND.	WIND.
EXCEPT WET FROM N. ED.	EXCEPT WET FROM N. ED.

Long foretold, long last; Short notice, soon past. First rise after low. Foretells stronger blow.

The same directions are adapted to the southern hemisphere, by simply substituting for the letter N the letter S, reading south for north, and *vice versâ*.

The following words are of universal application in the interpretation of the barometer movements:—

RISE.	*FALL.*
FOR	FOR
COLD	WARM
DRY	WET
OR	OR
LESS	MORE
WIND.	WIND.
EXCEPT WET FROM COOLER SIDE.	EXCEPT WET FROM COOLER SIDE.

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Again, the accuracy and form given to barometers especially the general accuracy and extreme portability now given to the aneroid, enable travellers and tourists to make extensive use of the formula by the great Laplace, for determining differences of elevation from the observed differences of atmospheric pressure at an upper and a lower station; and the dependence which can be placed upon thermometers, by good makers, has equally led to the employment of the boiling-point of water as the means of measuring great heights, by the application of the tables of aqueous vapour temperature in relation to pressure, as perfected by Regnault. That a traveller by means of a small instrument not larger than a watch, should be able, amid the snow and the glaciers of the Alps, or upon an arid plateau of Africa, to tell at a moment, within about one hundred feet for certain, his elevation above the level of the sea, is a triumph of science no less wonderful than that of the sextant by which the seaman ascertains his latitude. With due precautions the method is surprisingly correct, as has been repeatedly shown by trigonometrical measurements. For practical purposes it is all that can be desired for contouring mountains or districts of hilly country. It is unnecessary to mention how valuable these results are to the science of geography.

Applications to Navigation:—The works of Sir W. Reid on the *Developement and Progress of the Laws of Storm* have completely revolutionised the art of navigation. For the typhoon, tornado, the gale, or the hurricane, the mariner has now little dread. He confidently battles with the tempest, armed with the instruments of science, and clad in the armour of knowledge. Whatever may, or may not, be the capability of the cyclonic theory in accounting for the grand disturbances of the atmosphere, this much is indisputable, that since mariners have learned to apply the rules for navigating a ship in a tempest, as first laid down by Reid in accordance with his theory, there have been fewer casualties and total losses in the open sea from tempestuous weather.

Traceable from the labours of Capper, Redfield, Reid, Piddington and Dové, the foremost investigators of the winds, is the system of *storm signals*, now so beneficial to the maritime interests of the kingdom. The honour of inaugurating this system falls to Admiral Fitz Roy, and is a result of the government aid in furtherance of meteorology. It is no part of our intention to explain here how warnings of storms are signalled on the coasts; suffice it to state that the storm's approach can generally be foreseen, and the telegraph obstripes its march.

Well, then, may it be asked, who more than mariners are benefited by meteorology? Not only have the laws of storms taught them to guard against the worse features of the cyclone, to avoid its most dangerous part, but even to take advantage of its strength. Not merely does the storm signal caution them of the danger of leaving port, but their instruments are at hand to warn of impending changes of weather. How many thousand pounds sterling are annually saved, in prevention from loss of canvass, spars, masts, and rigging, by attention to the indications of the barometer, no one can estimate. How many ships have escaped wreck by the skill of the navigator in applying the laws of storms, by his attention to the storm warnings, by his observations of the glasses even, no one can tell. These are problems beyond the reach of arithmetic, but not beyond the mental estimation of those who are competent to judge of the results which might have occurred in the absence of such knowledge. Because the wrecks last year are not less than in the year before, shall it be said that this knowledge is without value? Has not the number of ships greatly increased? It is not possible that a ship which went to sea in the face of the storm signal and perished did so in consequence of the signal, while it is highly probable that of those ships which remained in port until the storm was past, some would have been wrecked had they gone to sea in the face of the menaced danger. One such ship might be worth several hundred thousand pounds sterling, and this one saving to the industry of the country would pay the cost of the storm signals to the nation for the better part of a century to come, at the present rate of expense. Fifty ships, nay one or two hundred,

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would make very little addition to the total yearly loss in the minds of many unthinking persons. Imagine then that the casualties have been less by only fifty during the year by the efficacy of the storm signals, what an inestimable blessing therefore must they be to human life, industry, and comfort, and what a ridiculous set-off to this immense saving of life and property must be the loss supposed to be incurred by a few days' demurrage; we say supposed, for a ship which weathers a gale may yet be disabled, detained or driven out of her course by it, so as to lose more days on her voyage than if she had remained in port to avoid it.

Nor is the probable preservation of the lives and property of our fishermen, boatmen, and coasters, by warnings of treacherous weather, less significant. They appreciate, equally with the great maritime interests of the country, the warning "cones" and "drums;" let them not therefore be swept into the limbo of the past by those few whose interests lie in opposing them.

Application in forecasting Weather.—This has been an attempted application of meteorology from the earliest ages of the world, but it does not appear probable that the ability to predict with absolute certainty the physical changes which constitute the weather will ever be attained by man. From signs observable in animal and vegetable life and in physical conditions surrounding him, man has always attempted to draw conclusions as to the vicissitudes of weather. Since the advent of science he has invoked instruments likewise; yet he has never been able to get on well with either. He has done better as his knowledge of meteorology increased, and now can exercise his judgment upon the weather with advantage, but not unerringly. Instrumental means and scientific knowledge seem the most reliable bases for weather wisdom. Aided by the electric telegraph, which may be said to annihilate distance, Admiral Fitz Roy has inaugurated a new method of procedure in foretelling weather, which enables him to construct what he has termed "forecasts of the weather." A great mistake is committed by any one who supposes that unerring ability to predict weather is claimed for this system. Any person having instrumental means and sufficient information of natural laws may make forecasts for his locality. The telegraph transmitting observed facts to such a person at a central station, from stations sufficiently numerous and well disposed, enables him to make forecasts for each station, and combining the whole he is able to predict the changes of wind and weather for a whole country. But the errors and fallacies liable to mar the judgment drawn by a weatherwise person from what he sees around him, must be increased by distance, and be more likely therefore to make his conclusions uncertain, however experienced and sagacious he may be. Yet it would be absurd to conclude that the object is useless, because it is not always attained with certainty. There are many classes of the community who, unable to make such mental calculations for themselves, are greatly benefited by a knowledge of probable weather two days in advance, derived from the newspapers. The forecasts of the weather issued from the government Meteorologic Office, are serviceable to the whole community, from the farmer, whom they may aid in avoiding the risk of spoiling a crop, to the excursionist whom they may apprise of inclement or genial weather.

Meteorology is, indeed, now competent to impart such knowledge respecting the sequence of atmospheric phenomena as will enable any person of average capability, assisted by a few instruments, to foresee the general character of the weather a day, or two days, in advance. Such knowledge to farmers, gardeners, shepherds, fishermen, seamen, travellers, sanatary engineers, and medical men, is of unquestionable advantage, as their vocations and duties are much influenced by changes in the weather; while to almost all people it cannot but be useful, seeing that the health and pursuits of all are influenced more or less by changes in the weather.

It is not our intention to presume to be able to give instruction in forecasting weather, but it may not be out of place to indicate what appears to the writer to

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be the *modus operandi* of the system of forecasting weather.

A person to be able to forecast weather for his immediate locality must possess the necessary instrumental observations, and be familiar with Dove's theory of wind gyrations and the corresponding normal variations of the barometer and thermometer, as well as the peculiarities of the winds as regard moisture. To forecast weather for any specific area, it is necessary to possess in addition, a knowledge of the geographical distribution of atmospheric pressure, and temperature, of the latter, also, as it depends upon the seasons. He should know the general peculiarities in the barometric pressure dependent on and indicative of, wind direction, and its strength, the influence of prevalent winds upon the normal temperature, and their rain bearing properties. Then through the telegraph he must be provided with daily observations simultaneously taken at the remote limits of his district, sufficient to enable him to express numerally the differences of atmospheric pressure, temperature, humidity, wind direction and strength, cloudiness and sea-disturbance. The differences, greater or less, considered as statical pressures must give rise to moving forces of corresponding greater or less intensity, in the mobile air. Admiral Fitz Roy has also found that allowance must be made for the general lateral translation of air in the temperate zones to the eastward. By some this is spoken of as a new discovery, but we apprehend it is only a fact now become more apparent since the method of forecasting was commenced, as it is the necessary corollary to Hadley's theory of the trade-winds. In addition to all this, the contact and collision of aerial currents, whether lateral or superposed, the result of the conflict of the trades and anti-trades in temperate latitudes, must always be carefully considered. With indefatigable zeal Admiral Fitz Roy has laboured to develope his method of forecasting weather, which in our belief cannot but be serviceable to the nation; he has done great service to meteorology by opposing the doctrine of atmospheric waves which has been written upon in an awfully mysterious manner for many years, he has also improved the theory of cyclones, and has done much to extend the employment and teach the true interpretation of weather instruments.

To point out how meteorology has its practical results in establishing the normal conditions and variations of weather, which constitute what is termed climate, whereby the foundation is laid of the extending practical science of climatology, is for us too great a task. Foremost in this field is Mr. J. Glaisher, among English meteorologists.

We have been induced to consider these practical applications because even at this day there is prevalent a too generally erroneous notion, "that meteorology, as a science, has no other object but an experimental acquaintance with the condition of those variable elements which from day to day constitute the general and vague result of the state of *weather* at any given spot; not considering that while such heterogeneous elements can be of little avail, when viewed as groups of facts, towards forwarding any one end of the science, or giving us any precise knowledge regarding it, yet that the careful study of the individual points, when grouped together with others of the same character, may afford the most valuable aid to scientific generalization.*" S.

* Professor J. D. Forbes, on Meteorology, in *Reports of the British Association*, vol. i.

DEEP-SEA THERMOMETERS.

In the *Report of the United States Coast Survey for* 1860, is a lecture on the Gulf-stream by the superintendent of the survey, Professor A. D. Bache, who gives therein the following information relative to thermometers for ascertaining the temperature of sea-water at great depths. In this age of sub-oceanic telegraphs, observations upon the temperature of the oceans below the surface, are of much speculative and practical interest; and the necessity of constructing an instrument which will register the temperature of sea-water without its indications being affected by the pressure of water at great depths, will be sufficient reason for asking our readers' attention to the quotation.

"The instrument for determining temperatures should fulfil the two conditions of

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registering its indications and of being unaffected by pressure. The common mercurial thermometer, while it answers perfectly for the determination of temperatures at the surface, fails in both the conditions stated. The ordinary self-registering thermometer, or self-registering metallic thermometer in the watch form, as made by Breguet, Montandon, and Jürgensen, when provided with a suitable cover to protect it from pressure, answers a good purpose, and has been extensively applied in the course of the observations (made in the Gulf-stream). As a rule, it is only the minimum temperature thermometer that must be used, as the temperatures decrease generally in descending. An ordinary self-registering minimum thermometer placed in a glass globe was successfully used by Commander C. H. Davis and Lieut. G. M. Bache. It has the disadvantage of taking the temperature slowly, and of being inapplicable below a certain depth. Small hollow cylindrical brass vessels, which were divided in two parts, closely fitting by grinding, and within which the Breguet thermometers of the watch form were placed, were an improvement upon the globe, as taking the temperature of the sea more rapidly; but, besides the difficulty of making the joint tight, they were crushed by the pressure at even moderate depths. The substitution of the globe for the cylinder extended the range of these instruments, but the thermometers were often crushed or injured by the access of the sea-water to the interior of the globe. Six's self-registering thermometers, as bearing considerable pressure without injury, and without rendering the indications erroneous, and as requiring no case to enclose them, except to prevent breaking from accidental knocks in handling, are very useful. They are still favourites with many of the officers, though others complain of their great liability to derangement, especially if the mercury is not perfectly clean, when the mercurial column easily separates and some skill is required to bring it together. These instruments are, from their cheapness, still furnished to the parties, and are used successfully at depths reaching about one hundred fathoms, and on occasions considerably lower. Keeping them in order requires the skill of an experimenter rather than that of an observer, and hence they do not satisfactorily fulfil the conditions of the problem. The metallic thermometer of Joseph Saxton, Esq., is based upon the coil form of that of Breguet. Two stout ribands of silver and platinum are coiled and carefully united with silver solder, the more expansive metal in the interior. A coil of gold, to which each is soldered, serves to prevent the tendency of the silver and platinum to separate. The lower part of the coil is fastened to a brass stem, which passes up through the axis of the coil, while the opposite end, to that at which the stem is attached, is firmly fastened to the base of a short cylinder, which keeps that end of the coil from turning, and so gives the whole motion of the opposite end of the coil to the stem, which in turning indicates the turning of the coil from the relative expanding or contracting of the metals composing it. In this short cylinder are the wheels which serve to magnify the motion of the coil, a hand upon the dial indicating the motion, and pushing before it a registering hand, moving with sufficient friction merely to retain its place when thrust forward by the index hand of the thermometer. These instruments are graduated by trial. The brass and silver portions receive a thick coating of gold by the electrotype process, to prevent the action of the sea water upon them. When kept cleaned by frequent washing in fresh water, and in good order, and frequently compared with the standards to guard against accidental derangements, these thermometers answer admirably all the required conditions. The length of the coil measured along its axis should not be less than six inches, as the interposition of wheels to magnify the motion should as far as possible be avoided. The water being all around the coil, which is a good conductor and has a low specific heat, the instrument readily feels the temperature of the part of the sea where it is exposed, and registers it to less than half a degree (say 0°.2) with certainty. The box which covers the coil and indicating part of the thermometer is merely to protect it from accidental injury, and is open so as to permit the sea water to pass freely through it. Although there seems no reason to doubt that this instrument is free from any effect from pressure, it was deemed desirable to try it actually by extreme pressure, and a series of experiments made by J. M. Batchelder, Esq., showed that at pressures less than that corresponding to 600 fathoms the effect was less than one degree (·25 to 1°); and at pressures from 600 to 1500 fathoms the change amounted to little more than from 7° to 9° F., the index returning when the pressure was removed. For great depths the effect of pressure must be ascertained,

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as it is specific in each instrument, and probably chiefly depends upon some mechanical defect in the construction, as in the soldering. The apparatus used in these experiments on the effect of pressure was a very ingenious one for testing hydraulic engines by Mr. Thomas Davison, of the Novelty Iron Works of New York."

CORRESPONDENCE.

To the Editor of the Horological Journal.

Sir,—As many who have read Mr. Tichiner's letter in the Journal will believe he has been deprived of the merit of some valuable improvement of the Lever Escapement, allow me to make a few remarks, with the view of correcting such an impression. From your readiness to accede to his request for publicity, I presume you are not aware that his escapement was submitted to the Society of Arts, some years since, without his being able to convince that body of his right to the title of inventor or improver. From that time he has made a continuous complaint of the injustice done him. First he claims the original application of the solid impulse Lever in making what he calls the three-pin Lever Escapement, together with the insertion of a gold plug, as a substitute for the discharge pins, and in which the impulse notch is formed. Secondly, he claims the original application of ruby as a substitute for, and improvement of, the metallic original. As a refutation of the first it is well known the late Mr. Glasham made solid impulse levers of gold, many years before your correspondent's provisional registration, 1855.

Mr. Hutton's patent (now out of date) comprised all that is now claimed, having a ruby discharged stone and notch all in one piece inserted in the roller, together with Glasham's lever, the ruby being the exact form of the Tichiner plug, yet he (Mr. T.) subsequently adopts the stone work as his improvement. In addition to the above, Mr. Box introduced the ruby impulse guard eighteen or twenty years since. This Mr. T. also maintains was the product of his own genius. The perusal of the above will show, that instead of being deprived of merit he claims that which is due to others.

It is but justice to George Savage, the inventor of what has hitherto been known as the Two-Pin Level Escapement, to state that there is very little of the so called improvements, but what he produced in principle. He jewelled the roller by inserting two slips of ruby in the edge, to form the notch. He also introduced the triangle stone not only as a substitute for the discharge pins, but in making the variety of lever, known as the Anchor Escapement.

It may further be remarked that the ancient lever watch in the possession of the clockmakers' company:—described in the *Horological Journal* Vol. II. p. 160 is furnished with a jewelled escapement which might have been suggestive to the above mentioned inventors. Yours truly,

J. L. Tilling.

To the Journal Committee.

Gentlemen.—In the "Address" prefacing the September number of the Journal I find it stated, that "Mr. E. D. Johnson undertook the risk of the cost of engraving the Portrait, &c." This is quite a mistake. The entire credit of the enterprise belongs to Mr. B. Woodcroft * * * *. I am hereby placed in so false a position both with Mr. Woodcroft and the public that I trust you will publish this letter * * * *.

Yours &c.,

E. D. Johnson.

[This mistake arose simply from a misconception of the case. The above correction, which was sent to the committee on the same day that the Journal was delivered to Mr. Johnson, will it is hoped satisfy both parties.]—Ed. H. J.

A NEW ALLOY.

"A new alloy, described as applicable to the manufacture of all metal articles, bells, hammers, anvils, rails and non-cutting tools, has been patented by M. M. H. Micolon of Paris. The alloy consists of iron or tin waste, 80 parts of steel, 4 parts of manganese, and 4 parts of borax; but these proportions may be varied. When it is desired to increase the tenacity of the alloy, 2 or 3 parts of wolfram are added. When the copula is ready; the iron and steel are poured in, and then the manganese and borax; finally, the vessel is filled up with coke, the metal is thus in direct contact with the fuel in the copula, and by quickly running the fused mass into moulds, bells which possess the sonority of silver and at a less cost than bronze may be obtained." — *Practical Mechanics' Journal.*

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ABRIDGEMENTS OF SPECIFICATIONS OF PATENTS

RELATING TO WATCHES, CLOCKS, AND OTHER TIMEKEEPERS.

1853, January 5.—No. 26.

EDWARDS, Francis.—"Transferring to enamel the impressions printed in suitable oils or inks, obtained from engraved plates or by other means, to serve instead of painting such work on the enamel by hand." The patentee transfers to enamel, impressions printed with any suitable oil on a glutinous material formed into thin sheets, by which method the groundwork of any design to be executed is at once obtained on the surface of the enamel, and such oil impression is sufficiently viscid to retain finely ground enamel or metallic oxides when dusted over it, which, adhering only to the transferred oil impression, is then ready for the customary firing process. Or by a method of charging the surface of the enamel with spirits of turpentine, printed impressions on paper, made with ink composed of a suitable oil and powdered enamel or metallic oxides, complete impressions may be transferred at once, and fired. The above may, among other things, be applied in manufacturing dials.

[Printed, 3½*d.*]

1853, January 21.—No. 151.

KNIPSEHAAR, Abraham Anton Meijsenheijm.—*Void by reason of the Patentee having neglected to file a Specification in pursuance of the conditions of the Letters Patent.* The Provisional Specification declares this invention for "An Illuminated Night Clock" to be "a method of constructing a receptacle which, being supplied with oil, will not only afford a night light, but by means of certain apparatus connected with the surface of the oil, and the hand of a dial plate to be affixed to the receptacle itself, cause the hand as the oil is consumed to pass round the face of the dial at an equal and measured rate, and thus denote the time."

[Printed, 2½*d.*]

1853, January 21.—No. 154.

NEWTON, William Edward (*a communication*).—The invention consists in shewing the days of the week, and month, and year, as well as the time of day, by means of a train of wheelwork which is independent of the ordinary clockwork, and is only acted on once in 24 hours, an independent spring being adapted to actuate the mechanism. The calendar wheelwork is so arranged that the proper number of days is made in each month of the year, including leap year; and only requires winding up once a year. The above is accomplished by means of a "count wheel" operating similarly to the striking part of an ordinary clock, but having thirty-one notches, one of which it moves every day, making an exact revolution in every month, long or short; on the same arbor is a wheel with twelve divisions on its rim, six of which are notches; it also has a star wheel attached to it of twelve teeth. This wheel moves one division each month, making an entire revolution once in a year. This inside wheel of twelve teeth is so arranged that it will work upon and raise two "lifting pieces" for the purpose of closing and opening three of the notches in the count wheel, by which means the number of notches in the count wheel always corresponds with the days of the month.

[Printed, 5½*d.*]

1853, February 2.—No. 284.

SMEETON, John.—*This Invention did not proceed to the Great Seal.* In his Provisional Specification the patentee says:—"My improvements consist in making dials of glass instead of copper or other metals, and in writing on either side the letters, figures, characters, or designs commonly used on dials, and by my improvements no enamel is required to be used for the faces of dials. I take a piece of glass cut or blown to the required size, and write in the letters, figures, characters or designs intended on either side of the glass, but I prefer doing so on the inner side, in which case they must be written reversed; I then place over these letters, figures or designs of a coat of composition in imitation of enamel of any colour, such as white cream colour, &c.; or I can imitate silver, bronze, or gold on glass dials, and produce a good effect with great economy. When necessary to attach or unite the glass dial so made to any other material, such as horn, bone, ivory, or metal, an adhesive composition must be used."

[Printed, 2½*d.*]

1854, November 9.—No. 2,381.

TUNKS, David.—The substitution of a worm or spiral, instead of a pinion, for giving motion from one wheel to another in all clocks, watches, and timepieces.

[Printed, 5*d.*]

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., AUGUST, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12.)	At 9A.M.	During the next 24hours.
	Inches.	o	o	o	o				
1	30.098	61.5	57	78	54	WSW	2	b	bc
2	.140	60	55 5	70	49	NW	3	b	bc
3	.168	58	53.5	69	47	W	1	b	b
4	.078	62·5	57	73	52	WSW	2	bm	b
5	.174	66	61	78	56	W	1	b	b, o
6	.130	68	63	84	60	CALM	0	o	cb
7	.063	63 5	59	80.5	52	W	2	c	b, c
8	29.879	68	65	78	60	W	5	o	bc
9	.924	57.5	56	79	53	NW	1	r	rr, b
10	30.053	56	50	69	47	WNW	5	b	b
11	.318	55	50	65	47	NNE	2	b	b
12	.388	55	50	68	45	N	1	mb	b
13	.372	61	57	74	50	E	1	b	b
14	.471	62	59	77	51	E	1	cb	b
15	.457	62	58	78	51	N	1	b	b
16	.336	60.5	59	72	50	NE	1	or	o, bc
17	.131	59.5	56	75	54	ENE	2	c	b
18	.056	54	50	75	46	NNE	2	b	b
19	29 788	53.5	51	65	46	CALM	0	mb	b, p
20	.788	54	52	68	48	N	2	o	o, b
21	.891	58	55	65	47	WSW	2	mb	rltt, bc
22	30 012	52.5	50 5	62.5	42	ENE	2	bc	bc, r
23	29.745	51 5	50	64	48	NE	4	r	rcq
24	30 048	51	48	56	44	NNW	5	b	bc
25	.226	51	48	61	41	WSW	1	b	bc
26	.302	52	49	60	44	N	2	b	bc
27	.377	51	48	64	42	CALM	0	b	c
28	.185	61·5	57	64.5	50	WSW	3	o	o, r, c
29	.106	61	58.5	67	54	WSW	3	c	bc
30	29.965	60	57	74	49	E	2	b	bc, p
31	.805	66	65	74	59	SSW	8	r	r, b
	30.112	58.5	55	70.6	49.6	—	2.2	—	Means

REMARKS.

The winds, according to the 9 a.m. observations were in the proportion of 9 N, 6 E, 2 S, 11 W. to 3 calms.

Rain fell on nine days to the amount of 1.29 inches.

The winds were more northerly than usual, therefore as might be expected the mean barometric pressure is above the average, the mean temperature by day and by night below the average, and the rainfall deficient in amount. Thus notwithstanding the weather was oppressively hot in the forepart of the month the equally noticeable cool period at the latter part brought the mean temperature 2 below the normal value. The rainfall was more than an inch less than the average depth for the month at London.

In a summary of the harvest prospects, in the *Shipping Gazette* of September 2nd, it is stated that the yield of wheat on the heavy lands is, taken as a whole, a full average; but on the light soils there is a deficiency. We have grown quite as much wheat as in the general run of years notwithstanding the drought which has prevailed during the last two months. Everywhere the quality is remarkably fine. Last year, which produced the finest crop both as to quantity and quality ever known, the samples weighed 66 lbs. and even 67 lbs. per bushel. This season the weight may be taken at 63 lbs. to 65 lbs. There is therefore, a slight falling off in the weighing qualities of some of the wheats. In Ireland and Scotland the bulk of the wheats have been carried in fine condition.

EQUATION OF TIME TABLE

FOR OCTOBER, 1864.

Day of the Week.	Day of Mth.	At APPARENT NOON. Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *added* to Mean Time.
		m. s.	s.	m. s.
Sat....	1	10 28·90	0·787	10 29·04
Sun ...	2	10 47·62	0·774	10 47·76
Mon ..	3	11 6·02	0·760	11 6·16
Tues...	4	11 24·09	0·745	11 24·23
Wed ..	5	11 41·80	0·730	11 41·94
Thurs .	6	11 59·15	0·715	11 59·29
Fri	7	12 16·12	0·699	12 16·26
Sat	8	12 32·68	0·682	12 32·82
Sun ...	9	12 48·82	0·664	12 48·96
Mon ..	10	13 4·52	0·645	13 4·66
Tues...	11	13 19·77	0·626	13 19·91
Wed ..	12	13 34·55	0·606	13 34·69
Thurs .	13	13 48·83	0·584	13 48·96
Fri	14	14 2·57	0·561	14 2·70
Sat	15	14 15·78	0·538	14 15·91
Sun ..	16	14 28·41	0·514	14 28·53
Mon ..	17	14 40·44	0·489	14 40·56
Tues...	18	14 51·86	0·463	14 51·97
Wed ..	19	15 2·64	0·436	15 2·75
Thurs .	20	15 12·77	0·408	15 12·87
Fri	21	15 22·22	0·380	15 22·32
Sat	22	15 31·00	0·351	15 31·09
Sun ...	23	15 39·08	0·322	15 39·16
Mon ..	24	15 46·43	0·292	15 46·51
Tues...	25	15 53·07	0·261	15 53·14
Wed ..	26	15 58·96	0·230	15 59·02
Thurs .	27	16 4·10	0·199	16 4·15
Fri	28	16 8·49	0·167	16 8·53
Sat	29	16 12·09	0·134	16 12·13
Sun ...	30	16 14·91	0·101	16 14·94
Mon ..	31	16 16·95	0·068	16 16·97

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BRITISH HOROLOGICAL INSTITUTE.

PRIZE FUND.

DETACHED LEVER ESCAPEMENT.

No Essays on the Lever Escapement having been received on the appointed day and an impression having been gained by some of the subscribers that the cause of the defect was the demand of historical matter which was not within the convenient reach of practical men, at a meeting of the subscribers, held on the 14th October, it was decided that a further extension of time be granted, and that the following amended programme should be issued.

A Prize of Thirty Guineas will be given for the best "TREATISE ON THE DETACHED LEVER ESCAPEMENT AND ITS VARIETIES." It should treat of the subject generally, giving tables of proportions of the various parts for the ordinary constructions, and explaining the effects of variations in these proportions. It is also extremely desirable that the procedure followed by an escapement maker, in making the escapement, should be clearly described. To make the Essay still more practically useful, it should notify to the examiner the points to be especially tested and the best means of rectifying any discovered error.

Various tools for effecting the several measurements and for facilitating the completion of the escapement should also be described. The text would be more readily understood if illustrated by simple diagrams.

The completing Essays must be delivered in, on or before the 3rd March, 1865, under cover to the undersigned at the Institute.

Each treatise must be marked with some device or motto and should be accompanied by two envelopes; one superscribed by some motto, and containing the name and address of the writer, only to be opened if the Essay is successful; the other envelope to be addressed to Mr. KLAFTENBERGER, at the Institute, to contain the name of a gentleman proposed as one of the judges.

There will be three judges; two of whom have been nominated by a majority of the subscribers at a meeting of that body, viz., W. HISLOP, Esq., F.R.A.S., and A. WALSH, Esq., M.I.C.E., and the other one is to be nominated by the authors of the Essays as above. Should no one be nominated by the authors, or should there be an equality of votes, or should the person elected refuse to act, the election will be determined by a majority of the subscribers.

The judges will have the power of awarding a less amount, should none of the Essays be considered worthy of the prize offered.

The judges will be requested to give their decision in not more than one month from receiving the Essays for award.

The writer of the Essay to whom the prize shall be awarded, shall be entitled to the copyright, the subscribers reserving the right of publishing it in the Journal, in whole or in part, as they may think fit, but not till six months have expired after adjudication of the prize; and payment of the amount of award.

As the present announcement is but the opening of a plan for encouraging the publication of knowledge connected with the art, and for promoting improvement in the manufacture, the assistance of members of the trade, by subscriptions, is requested.

Intending subscribers are requested to forward their names or subscriptions, to the Honorary Secretary of the Prize Fund, at the Institute, or through any subscriber to the fund.

Subscriptions will be acknowleged periodically in the *Horological Journal*, the pages of which are open to communications on the subject.

JNO. JONES, *Chairman of Committee of Prize Fund,*
RD. STRACHAN, *Honorary Secretary to the Committee.*

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WEIGHTS AND MEASURES.

The greatest of our living philosophers, Sir J. F. W. HERSCHEL, is not an advocate for the introduction of the metric system of weights and measures. He supports his preference for the existing state of things in the following arguments which have appeared recently in the *Times:*

"Whatever be the historical origin of our standards of weight, capacity, and length, as a matter of fact our British system refers itself with quite as much arithmetical simplicity through the medium of the inch, to the length of the earth's polar axis (a unit common to all nations) as the French does through that of the metre to the elliptic quadrant of a meridian passing through Paris (a unit peculiar to France). It does so as regards our actual legal standards of weight and capacity with much more precision than the French system, and as regards that of length (with a correction which, if legalized, would be absolutely imperceptible, from the smallness of its amount in any transaction of life, and which can be applied, *currente calamo*, almost without calculation to any statement of lengths) with even still greater, and indeed with all but mathematical, exactness.

"If the earth's polar axis be conceived divided into five hundred million inches, and a foot be taken to consist of 12 such inches, then one hundred of our actual legal imperial half pints by measure, or one thousand of our actual imperial ounces by weight of distilled water at our actual standard temperature of 62° Fahrenheit, will fill a hollow cube having one such foot as its side. The amount of error in either case is only one part in 8,000.

"The theoretical French metre is one ten-millionth part of the elliptic quadrant above-mentioned; the theoretical litre is one-thousandth of a cubic metre; and the theoretical gramme, one-millionth part of a cubic metre of distilled water at 32° Fahrenheit. The actual error of the French legal or standard litre and gramme, or the deviation of these standards as they actually exist from their true theoretical value, is one part in two thousand seven hundred and thirty (2,730), and is consequently relatively nearly three times as great as the error in our own standards of capacity and weight when referred to the earth's polar axis as their theoretical origin in the manner above stated.

"Our actual imperial measures of length deviate, it is true, by more than this amount from their theoretical values so defined; that is to say, by one part in one thousand; so that a correction of one exact thousandth part substracted from the stated amount of any length in imperial measures suffices to reduce it to its equivalent in such units as correspond to similar aliquots of the polar axis; a correction performed if needed, as already remarked, *instanter*, and *currente calamo* requiring no tables and almost no calculation. So corrected the out-standing error is only one part in sixty-four thousand (64,000). The actual legal metre in use in France is, however, not immaculate in this respect, its amount of error being one part in six thousand four hundred (6,400), which is ten times that which our British measures so corrected would exhibit.

"If it were worth while to legalize so trifling an alteration (and were an act passed rendering permissive the decimalization of our own system, it would be necessary to do so as a means of bringing the national units of length, weight, and capacity into exact decimal correspondence), no mortal would be aware, practically speaking, that any change whatever had been made in our mile, yard, foot, or inch. I have in common use two foot rules bought at respectable shops, and neither the worse for wear, which differ by more than the amount of change required.

"England stands in extensive commercial relations with the States of North America, employing the British system of weights and measures. British commerce extends to Russia, British India, and Australia, all of them superior in area, and the two last, at least, of equal importance, commercially speaking, with the totality of the metricized nations. The Russian *sagene* is an exact multiple of the English foot (imperial). The *hath* (the legal measure of length in British India) is 18 imperial inches. The Australian system is identical with our own. Taking into consideration this immense preponderance both in area, in population, and in commence, we are not only justified in taking our stand against this innovation, but entitled to inquire, if uniformity be insisted on, why, with an equally good theoretical basis (to say the least), the majority is called upon to give way to the minority.

"It has been observed that 'it is not easy to believe that the inch or the ounce or any of our standard measures are founded

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on the polar axis' of the earth 'which can only be estimated.'

"No one has ever asserted that they are so—*i.e.*, in the historical sense of the expression. That axis was assuredly not in the contemplation of the Commissioners of Weights and Measures of 1818, or in those of 1838 (the more the pity). All that I maintain is that, as a simple matter of fact, they *do* stand in respect to that axis in those simple and easily remembered relations stated, so that if henceforward we were to adopt that axis as a natural unit of linear dimension, our actual system might still subsist without the smallest practical inconvenience; or if we were to alter by an act of legislation our linear standard in exact conformity to such a unit, nobody would ever become practically aware of the change or have occasion to disuse any one weight, measure, or denomination he might possess or be accustomed to.

"It has been asked, 'Can it be chance or accident which has given us ten pounds to the gallon, ten ounces to the half-pint, as well as 1,000 ounces to the cubic foot?' As regards the gallon and half-pint assuredly not. It was on the deliberate recommendation of the Commission of Weights and Measures in 1818 that the gallon was *altered* from the old Winchester gallon to the present imperial one of 10lb. avoirdupois of 7,000 grains each, and the coincidence of the arithmetical relations of 16 half-pints to the gallon and 16 ounces to the pound, which brings the half-pint to consist of ten ounces, is no result of accident, but of the natural and popular tendency to binary sub-division. On the other hand, the coincidence of the (geometrical) cubic foot with 1,000 ounces *is*, so far as I am able to perceive, a purely accidental (and, it must be admitted, a most fortunate) one. But, being such, and the coincidence being matter of ascertained fact, there is nothing to prevent our taking advantage of it to connect our weights with our measures."

It should be remembered, however, as an anonymous writer in the *Times* has remarked, that,

"Sir John's statement about the inch, and its relation to the earth's polar axis may be true; it cannot be proved, unfortunately, but of the true length of the yard (from which the inch is derived) there can be no doubt, as it can always be verified and accurately measured by the length of the pendulum."

At the meeting of the British Association, held at Bath, in September, a report on the subject of uniformity of weights and measures was read before the Section for Economic Science and Statistics, Dr. Farr, president of the section, being in the chair.

The report emanated from a committee, which consisted of Lord Wrottesley, Mr. Adderley, Sir W. Armstrong, the Astronomer Royal, Mr. Samuel Brown, Mr. William Ewart, M.P., the Master of the Mint, Sir John Hay, Professor Hennessey, Mr. James Heywood, Dr. Lee, Professor Levi, Professor Miller, Professor Rankine, Rev. Dr. Robinson, Colonel Sykes, M.P., Mr. Tite, M.P., Professor Williamson, Mr. Purdy, and Mr. Yates.

Mr. Heywood, before reading the report, stated that the meter was 3ft. $3\frac{1}{8}$in. long, and derived its name from the Greek word μέτρον, a measure.

The following are the recommendations of the committee:—

"1. That it is desirable, in the interests of science, to adopt a decimal system of weights and measures.

"2. That in furtherance of this proposal it is desirable, from its scientific capabilities, to adopt the metric system.

"3. That as the weights and measures of this country are gradually undergoing a process of decimalization, it would be more advantageous, instead of drifting by degrees into a heterogeneous variety of systems, to change at once to a really convenient system.

"4. That it be recommended to the Government, in all cases in which statistical documents issued by them relate to questions of international interest, to give the metric equivalents to English weights and measures.

"5. That in communications respecting weights and measures presented to foreign countries which have adopted the metric system, equivalents in the metric system be given for the ordinary English expressions for length, capacity, bulk, and weight.

"6. That it be recommended to the authors of scientific communications, in all cases where the expense or labour involved would not be too great, to give the metric equivalents of the weights and measures mentioned.

"7. That the influence of the British Association would be beneficially exerted in obtaining from Paris an authorized set of metric weights and measures, to be placed in some public and frequented building in London.

"8. That advantage will be derived from the recent publication of metric tables, by

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Mr. C. H. Dowling, C.E., in which British standard weights and measures are compared with those of the metric system. That treatises explaining the metric system, with diagrams, should be forthwith laid before the public. That works on arithmetic should contain metric tables of weights and measures, with suitable exercises on those tables; and that inspectors of schools should examine candidates for pupil-teachers in the metric system.

"9. On the subject of temperature, it is recommended that the authors of reports to be presented to the British Association relative to temperature be requested to give the degrees of heat and cold according to both the Centigrade and Fahrenheit thermometers.

"10. It is recommended that the scales of thermometers constructed for scientific purposes be divided both according to the Centigrade and Fahrenheit scales, and that barometric scales be divided into fractions of the meter, as well as into those of the foot and inch.

"11. That a committee on uniformity of weights and measures be reappointed."

Sir J. Bowring wished to mention two facts connected with this subject. The first was that at the recent Postal Congress at Paris, at which 16 Governments of Europe and America were represented, a resolution was unanimously adopted that the metric system should be universally adopted for postal communication, and that if adopted as a principle it would afford the greatest possible facility for the settlement of accounts and intercommunication generally. The second fact was this, that in China, where there were agglomerated no less than 400,000,000 human beings, the decimal system universally prevailed, and he had never heard of a boy of seven years who made a mistake in any account. He had even heard savages say that the decimal and metric system must have come from God. They found it the greatest blessing, because having their ten fingers they always carried with them the means of settling their accounts.

Professor Williamson bore testimony to the results of the experience of chymists in their use of the metrical system in operations of daily occurrence. He believed he might say that working chymists, with very few exceptions, were in the habit of using the metrical system in almost all their experimental operations, and they derived from it an advantage which nothing would induce them to sacrifice or exchange for that absence of system which at present prevailed in England. The question of introducing the metrical system into this country was not really a choice between two systems, it was between the only existing system and general confusion, which was so distressing and inconvenient as not only to impede, but actually to prevent a great number of operations which would be of the greatest importance in connexion with the advancement of science."

Mr. Ewart, M.P., disclaimed all merit in relation to the metric system. He was merely the representative—he might say the Parliamentary agent—of those much more learned men who first conceived the idea of introducing the metric system into England. He was most willing to act for them in conducting a laborious inquiry before a Committee of the House of Commons, and in passing a Bill which rendered permissive the adoption of the metric system in this country and the colonies. He certainly expected more opposition; but he was happy to say he had received the zealous assistance of men on all sides of the House. He referred to the great difficulties experienced in teaching and learning arithmetic in our schools, and observed that science, education, commerce, and, he might add, common sense, alike called for the adoption of the metric system.

Captain Maury speaking of the practical value of a common system of weights and measures, was prepared to endorse the statement of an eminent American statesman, who, in reporting to congress on this subject, said that the adoption of such a system the world over would confer as great a boon on mankind as the introduction of steam in reference to mechanical appliances.

The Bishop of Natal said:—

"I was present at Berlin last year when the subject was thoroughly considered, and where it is well known the greatest unanimity of feeling prevailed in regard to it. I believe that the time is come when a step may be taken, and ought to be taken decisively, to promote the introduction of the metrical system into general use among our people. I remember well my own schoolboy days, and the difficulties which I found in mastering the details of *Bonycastle* and other dreary books with which boys were plagued in those days. My arithmetical lessons were a pepetual misery, and if I was ever punished it was always certain to be for my sums. I could not understand the rules which the books laid down, and I suffered the penal consequences of such inability. Well, the remembrances of past misery compelled me, when I became

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a man, and was engaged myself in teaching boys at Harrow, to endeavour to relieve the pains of others, and I trust that my efforts, with those of other writers who have laboured in the same field, have not been altogether in vain. But, although matters are somewhat simplified in these days, they would be vastly more simplified if the metrical system were fully adopted among us. With respect to adopting French names, I do not think that that is of much consequence, or that we have any right to complain of being obliged to adopt them to some extent in consequence of their having been already introduced so extensively among almost all the nations of Europe. It is mortifying, no doubt, to an Englishman that we should be placed in this predicament, and be obliged to follow, instead of leading. But whose fault is that? We are among the last of civilized nations to reform our system, or rather our want of system, in this respect, and we must submit to the consequences. If we had led the van in this improvement, we might have commended our names to others. As it is, most probably these longer names of decimetre, dekametre, hectometre will be cut down to some shorter forms by practical Englishmen, but I imagine we must accept the metre, though we may make it English if we like by dropping the accent, and spelling it differently. Especially, however, I wish to express my hearty concurrence with the proposition which has just been made, that the influence of the Association should be used with the Government to induce them to require that in all schools assisted by the State the metrical system shall be regularly taught. It is possible that practical difficulties may exist in respect of such a proposal being carried out at once which may not occur to me on the moment. At present I see no such difficulty, except the want of elementary books adapted to the new system; and these would, of course, be prepared when the impetus is given by making such teaching compulsory in schools receiving State support. This would not be making the adoption of the metrica system compulsory on the nation at large but practically it would insure the adoption of it very generally, and would enable us to get rid entirely of the old cumbrous system in the next generation."

Sir W. Armstrong stated that he had found the adoption of the metric system an absolute necessity in his establishment, in order to enable them to work up to the precision and nicety required by the present times.

The report of the committee was adopted unanimously.

Mr. Bracebridge moved that the section recommend its committee to suggest to the Committee of Council on Education the importance of requiring that the metric system be taught in the schools receiving public grants.

Mr. Tite, M.P., said that an important practical suggestion had been made by the chairman, and he thought it was likely to be the means of introducing the thin end of the wedge, for the introduction of this change or any other in England could only be a matter of progress. He thought it important that Government should adopt the metric system in levying the duties on goods imported from France and other countries which use that system. As an architect he had, 20 years ago, had a great deal to do in France, and he found the adoption of the metric system of the greatest use in facilitating his operations, both in matters of minute measurement and account.

Sir B. Brodie recommended the adoption of the system in all national observatories and scientific institutions.

Dr. Lee said he was an old advocate for the adoption of the decimal system, but he preferred the old English yard to the metre.

The motion was adopted.

THE BRITISH HOROLOGICAL INSTITUTE.

CONVERSATIONAL DISCUSSION MEETINGS.

On Thursday, 29th September, a Conversational discussion took place at the Institute, the question being, "Is the Goldsmith's Company's mode and charges for Assaying and Stamping Watch Cases capable of improvement and diminution."

Mr. John Jones, *Vice-President*, in the Chair.

Mr. Jones opened the question by reading the clause in the act of parliament, Geo. II. cap. 26, clause xiii.

"XIII. And whereas the wardens and commonalty of the mystery of goldsmiths of the city of London, have for many years last

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past been at very great trouble and expences in assaying and marking wrought plate, and the same hath of late years very much increased by their assaying and marking several sorts of small wares of gold and silver which were not heretofore usually assayed and marked, and of which there are much greater quantities now made than were heretofore made; therefore for the better enabling the said company to defray such expences for the future, be it enacted by the authority aforesaid, That from and after the said 28th day of May, 1739, it shall and may be lawful to and for the said wardens and commonalty, and their successors, or such person or persons as the court of assistants of the said company shall authorize and appoint, to ask, demand, take, and receive of and from all and every such person and persons as shall from time to time bring or send to the assay office belonging to the said company, any piece or parcel of wrought plate of gold or silver to be assayed, tried, and marked, such prices, sums of money, or rewards, as they shall from time to time think fit, so as such prices, sums of money, or rewards, do not exceed the several and respective prices, sums of money, and rewards following; that is to say, for assaying, trying, and marking gold watch cases or gold watch boxes, ten-pence apiece; for gold hooks for watch chains, ten-pence apiece, for gold buckles, five-pence apiece; for gold snuff boxes, fifteen-pence apiece; for every other piece or parcel of wrought gold weighing thirty ounces or under, twopence and six shillings; for such piece or parcel of wrought gold weighing above thirty ounces to fifty ounces, three shillings and nine-pence; and so in proportion for greater pieces or parcels."

Under which the Goldsmith's Company are empowered to stamp and charge for stamping. Gentlemen, such is the basis of our consideration this evening. We meet to examine whether the prices charged by the Goldsmith's Company are in accordance with the act of parliament, whether, supposing such be the case, they are at the present time reasonable and proportional to the market value of the work done, whether the method of stamping admits of improvement, whether the scraping of the cases for material for the assay is necessary, and whether, if so, the present manner in which it is done is the right way, having in view the least possible injury to the work of the case maker. The purpose of our meeting is entirely coincident with the purpose of the act of parliament, which I have referred to. It was for the supposed advantage of the general trade of the country powers were given to the city guilds to supervise, not only the materials, but the quality of the work in the several trades over which they once presided. The examination and condemnation of the quality of work was too indefinite a power to be exercised in later days, so that branch of public duty has fallen out of use. The Goldsmith's Company, however, still retains the right and practises the right of examining and marking watch-cases, in which we are concerned. I am not aware that any particular objection exists against that particular body using this power, it is true, that out of the twenty-four members of the court of assistants, there are only two or three who have any knowledge of the duty they undertake for the public. Highly respectable men no doubt they are, but one engaged in selling tea, another sugar, another corn, give in their personal abilities, no guarantee to society for their competence in the analysis of metals. Of course, therefore, they must trust themselves in the hands of some irresponsible persons in selecting the officers who practically carry out the corporate duties, and of course they are incapable of judging whether the servants they employ, are properly discharging the duties the corporation owes to the public, and that duty they owe to the trade. For the capacity or incapacity, however, of the assay masters I cannot answer further, than owning that I have not heard any complaint against their skill. Against the practice of having our cases stamped, I am not aware that any general opinion exists. The custom is old, and it may be in the minds of many of the public, the stamp on the cases is a source of confidence. I think to speak freely, it is overestimated as to its importance. Trade is sufficiently independent, the public sufficiently intelligent now, I believe, to stand without the guarantee of such an anomalous body as I have just described. The personal certificate of a manufacturer, that the gold in his case is 18 carat, would appear to me as safe a reliance as the stamp of the company. Since I believe

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it would be under proper cross-examination, a difficult thing for any officer of the company to prove that a particular stamp on a case was or was not impressed at the Hall. Since there is nothing distinctive in the merits of the die, and the stamp is largely copied abroad, especially in America, on cases of inferior gold, where it tends rather to damage than assist our home manufacture; besides, the necessary methods of restoring the form of the bruised article after stamping, tends greatly to diminish any powers of indentification. So that I regard the stamp as an imaginary, rather than a real guarantee, but at present I have not heard any general disapproval of the marking of the cases. I think then, gentlemen, we had better confine ourselves to two or three points, and listen to each others remarks on them in succession, that we may come to separate resolutions, which supposing that they point to further measures would enable us to go before the Court of Assistants of the Goldsmith's Company, either by deputation, or by letter, and ask for such arrangements as we feel to be proper, and in the case of failure on this step, enable us to proceed to the Board of Trade to ask the government to assist us in removing obstructions which a century ago, when they were enacted, might have suited the then condition of the trade, but which in the face of the greater facilities enjoyed by our competitors in Switzerland and France, go far to deprive the workmen of this country of a chance of a fair race, and largely conduce to the destruction of the trade of English Watchmaking.

I shall now be happy to hear any remarks on the first point which I would submit, viz., the cost of stamping. We will then take the stamping, then the scraping, and then any other point of suggestion in reference to our purpose of giving every facility to our manufacture, and removing every unnecessary obstacle. I shall be glad to hear then any remarks in reference to the cost, premising that there is a clause which limits the Goldsmith's Company from making any profit on the work they do. Mr. Jones read the clause.

"XIX. Provided likewise, and it is hereby enacted and declared, that in case the said prices, sums of money, or rewards hereby given, granted, or allowed for the assaying, and marking wrought plate, shall raise more money than shall be sufficient to defray the necessary expences of the said respective assay offices, then the overplus money (if any) shall be applied from time to time in the prosecuting offenders against this act; and if such prosecutions shall not require the whole overplus (if any), that then the said prices, sums of money, or rewards, shall afterwards be lessened in proportion by the said respective companies of goldsmiths; and they are hereby required to take so much less for the assaying, trying, and marking wrought plate for the future, as will answer the purposes aforesaid only, without bringing any profit to any of the said respective companies; anything herein contained to the contrary hereof in anywise notwithstanding."

Mr. Holliday said that he did not think the cost of stamping was as important as the method of stamping. He did not think that the charge for stamping was excessive, if a man carefully scraped the several parts of a case, the edge bezils and bottom, he thought that was worth sixpence, if they could come into the case maker's shop and do it, it would save a great deal of time and trouble. He said that the charge for stamping an open-faced or hunting single bottomed gold watch case was ninepence. an open-faced or hunting double bottomed gold case was one shilling and sixpence. The cost of stamping a gold bow and pendant was threepence. He did not think that it would be any good to the public if the company lowered their prices, he knew a pendant maker who obtained for that branch of the trade a reduction from fivepence to threepence, some years ago, but he made his pendants no cheaper. What he most objected to in the charges was that the Company when they broke up the work for defect of quality in the gold still charged for stamping, so that the case maker lost both the value of his work, and the cost of assaying and stamping, otherwise he thought the Company very honorable in their conduct, if they accidentally damaged your work, they would pay you for the injury done. There were complaints he had to make occasionally of delaying the work in the Hall, so that he could not execute his

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orders to time. He thought the Company ought to employ more men, so as to deliver their work out at the proper time.

Mr. Nicole (Nicole, Capt.) said that he sent a single bottomed watch case to the Hall, but they charged him one shilling and sixpence, he explained that it was only a single case, but they paid no attention to his complaint, and they spoiled his work by their method of stamping. In Geneva the bottoms only were sent to the Hall, and the bezils and other parts were secured from deterioration by the law allowing an officer every week, at such times as he pleased, entering the workshop, and testing the cuttings and the sheets of gold or wire used in case-making, if any be found under 18 carat, a penalty was inflicted. In France all watch cases are stamped so that finished watches made in Geneva when imported into France are stamped without injury to the appearance of the case.

Mr. Holliday said that that was impossible. If you put an engine turned case on a flat iron, which was the best thing to put it on, he defied any one to strike a stamp on it without showing on the opposite side.

Mr. Tilling said that with reference to stamping he had had some practice, for he used to stamp all the cocks of the watches to which he made escapements, with his initials, but some of the manufacturers objecting, he now limited himself to stamping the tails of his levers with his initials. He found that by using a skeleton letter and striking with the lightest possible blow that no bruise was made on the other side.

Mr. Holliday said that might do on brass but gold was a very different material, and could not be so treated.

Mr. Nicole repeated that gold was easier to stamp than brass, that in France gold cases were stamped after completion without injury to the other side. He had his own cases so treated which he sent to the Exhibition at Paris. They both assayed and stamped them without disfiguring them, in the building itself. (They had a revolving anvil on which the gold was placed, and the stamp corresponded with each face of the anvil so that the combination of the two impressions could be registered as of a particular date.)

Mr. Holliday said that they could not assay a case after it was finished.

Mr. Nicole said they did, and indicated to him a superior excellence in the quality of his gold, which he always adopted to avoid the danger of his work being broken. They used the touchstone and acid.

Mr. Tilling said that even steel was perfectly practicable to stamp without injury, for he practised it that he might know which side of his lever to put next to his pallets when completing his escapement.

Mr. Holliday said he should like to see it done, for he did not believe it till he saw it. Mr. Tilling might come to his shop, and he would supply the gold, and Mr. Tilling might then convince him.

Mr. Jones remarked that it was hardly fair to ask Mr. Tilling to show his methods. Mr. Holliday has exhausted his knowledge in the use of the flat iron. Mr. Tilling ought to have a £5 note if he gave special teaching. Mr. Storer remarked that the Institute was for the purpose of publishing knowledge.

Mr. Jones said it must be used for the general information, not for Mr. Holliday's special information.

Mr. Glasgow said, that with reference to Mr. Holliday's remark, that the public would not benefit from reduction in cost of stamping, that we were here not only for the public but for ourselves; surely, if the money were in the pockets of the trade rather than in those of the Goldsmith's Company, it was to the advantage of the trade. With reference to Mr. Holliday's flat iron, we had nothing to do with that; in France all cases were stamped after the watches were finished it being illegal to sell any gold in France without the stamp. To press a relief stamp as was done by our hall was not the plan, an outline stamp could be used without injury. With reference to the words in the clause of the act of parliament, "watch boxes or watch cases each tenpence," he thought a legal opinion ought to be taken as to what was the meaning of that phrase, for no ordinary judgment would decide that an extra bottom was an extra case, and if an extra bottom was not an extra case, then the custom of the company in charging for it as an extra case, was not justified by the law.

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Mr. Thickbroom said that the prices for stamping silver watch cases, was for single open faces or single hunters, twopence each, for double bottomed open faces or hunters, fourpence each, for silver pendants and bows, half-penny each.

Mr. Holliday said that there was far less trouble in scraping and assaying silver than gold.

Mr. Nicoll and Mr. Thickbroom joined in saying that there was not so great a difference between silver and gold.

Mr. Mylne read two memoranda, one from a case-maker in England, the other from abroad:—

"The case-makers in the French Cantons, (Geneva, Neuchatel, &c.,) take the ingots to the Assay Office, belonging to the government and are not allowed to make cases under 18 carat gold. Good makers generally mark the bottom of cases 18 carats, besides their private mark. If a manufacturer doubts the quality of gold in the bezil, bow, rim, &c. of a case, he may take it to the Assay Office, and if found under 18 carats, the case-maker is subject to a heavy penalty. In the Canton, Berne, they are allowed to work as low as 14 carat gold."

"SUGGESTIONS.

"More care in scraping all the parts of the case to prevent defacement and destruction of snaps.

"A considerably less quantity taken off for assay, and not so many assays made off work weighing 5 oz. or upwards, thereby in light work nearly cutting through the bottoms.

"More regard in striking the marks to the strength of the bottoms, as in light work they are very often nearly through, and liable to make the bottoms split. In stout work the marks not being so heavily struck as in the light, thereby shewing great want of judgment in the process of passing through their hands."

He handed round some gold cases as they returned from the Hall. The bottoms were deeply bulged, the scraping had left a vacancy between the bezil and the case edge. The surface of the bottoms were as Mr. Nicole remarked, reduced about one-fifth in substance in the part where the scraping had been done. The edges were likewise scored as though by a file, Mr. Mylne asked Mr. Holliday what he thought was the quantity of gold taken off. Mr. Holliday thought 18 or 19 grains. Mr. Mylne remarked that Mr. Jones had on a former occasion informed them that 6 grains was, according to the statement of Professor Miller, of King's College, enough for an assay, but here 18 grains had been taken. Mr. Holliday said 6 grains was enough, but two assays were taken for verification. He, however, thought more care should be taken. He could not send a single case to the Hall, for they so distressed a single case that, if it were light, it was spoiled. Mr. Glasgow said his case maker would charge him ten shillings less fashion, if there were no stamping.

Mr. Nicole said that one-third of the cost of a case belonged to the system of stamping. There would be a different mode of procedure in making, if the coarse system of stamping were discontinued.

Mr. Glasgow moved that the discussion be adjourned to the following Thursday. That they might in the meantime learn in what quantities, as an average, cases were sent, for if two assays sufficed for twelve cases, it was not reasonable to charge 18*s*., exclusive of pendants for stamping, when 1*s*. was the market price, as advertised by one of the Court of Assistants of the Goldsmith's Company, for the one assay, for a private individual. If they knew the average number of cases sent, they would easier judge as to the proper charge, certainly single cases were not frequent, for they would suffer too much on the scraping.

Mr. Jones remarked, that it was not reasonable, that they who examined work should be better paid than they who produced it, the average rate of case-makers incomes ought to be a standard for assay masters' salaries.

ADJOURNED MEETING.

The adjourned meeting on the above question was held on Thursday, 6th October, Mr. Jones in the chair.

The chairman reminded the meeting, that the cause of adjournment was the propriety of ascertaining in what numbers the case-makers sent cases to be stamped, that they might have the materials for judging how far the Hall was justified in charging for six and twelve assays when

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one or two only were required. The other matters such as the correct reading of the act of parliament as to whether a double bottomed case was two cases, and as to the injury done in stamping had received sufficient discussion to enable them to come to a decision. He trusted therefore some one would propose a resolution which would enable action to result from this discussion.

Mr. Tilling since last evening's discussion, had experimented on gold and steel balances, by stamping initials on the under side of the rim, and found that the impression might be made without in the least disturbing the truth of the circle, for in the turns he had tested them, a relief stamp required double pressure to an outline stamp.

Mr. Mylne considered that they had elicited important and valuable information relative to the present mode of assaying and stamping cases, in this, and other countries, shewing the great necessity for alterations being made by the Goldsmith's Company, but to deal efficiently with the question, he thought it desirable that further information should be obtained by referring the matter to a sub-committee. Mr. M. moved that it be a recommendation to the Council, that a sub-committee be appointed to enquire into, and arrange the facts connected with this question, and that on their report a public meeting should be called to consider the propriety of a deputation to the Goldsmith's Company on the subject, and in the event of non-success, to the Board of Trade.

Carried unanimously.

ANTIQUE TURRET CLOCK.

To the Editor of the Horological Journal.

Sir,—I forward to you the enclosed short description of a very curious antique turret clock, which, if you deem worthy of insertion, may be a little interesting to some of the readers of the *Horological Journal*.

The clock was placed in the large square tower attached to the town church of Dundee, (the tower being locally known as the *Auld Steeple*,) but a short time ago was replaced with one of modern construction. At what time, or by whom this antique piece of mechanism was constructed, no positive information has been obtained. The tower is arranged in five floors (or *stories* as they are termed in Scotland,) on the fourth floor the clock was placed, and shewed the time on two dials, on two opposite sides of the tower. There was no *dial work*, consequently it shewed the *hour* only, having but one hand to each dial. The movement was made entirely, (with the exception of some modern additions made at various periods previous to its removal,) of malleable iron.. In form the frame was of an oblong shape, and of the kind termed *skeleton*, there being an upright bar at the four corners, these being connected at top and bottom, with parallel bars. The frame was divided into two parts at the centre, at which and at either end, was an upright bar in which were fixed the going train on one side and the striking on the other. In length the frame would be about eight feet, four feet in height and the same in breadth. The frame was *rivetted* together with the exception of the upright bars at either end. No file marks were visible in any part of its construction, but all as it came from the hammer and the forge. Its time of going was 48 hours, which necessitated its being wound every alternate day. The going train consisted of 3 wheels within the frame, viz.,—great wheel and barrel, second wheel and scape wheel, (the original scape wheel and pallets were removed a number of years ago.) Projecting at the outer end of the frame was a pinion fixed upon the barrel arbor. This pinion *geared* into two *contrate wheels* (not bevelled,) which were fixed to the rods on which were the hands. The barrel was loose upon the arbor, the click acting 4 times in one revolution of the barrel. The original mode of winding was by four spikes or handles inserted into the barrel at one end of it. The mode of winding was by clutching one of the handles with one hand, pulling it towards you, which then brought another of the handles within reach of the other hand, so that this hand over hand arrangement was carried on until the clock was wound up. (For many years one of the rooms of the tower was occupied as the town jail, prisoners having

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hard labour assigned to them, had the duty of winding the clock as part of their punishment, but on the removal of the jail a more *civilized* system of winding was adopted.) The fall of the going weight was about 80 feet, so that it was a laborious matter the winding. The weight was a huge rough sea side boulder in which a ring was inserted. To this ring was attached a wooden pulley, with strap. The pendulum was about 12 feet long weighted with an unshapely piece of lead, The pendulum was here made with a curve to allow it to vibrate free of the barrel arbor. It was quite a common occurrence of late years, during a strong gale, for the pendulum bob to be stopped by the wind blowing upon it through the *lower boards* of the room into which it hung, the result being (the pendulum being very flexible) it vibrated at its centre while the bob was almost motionless the clock would then go at a furious rate. The striking train consisted of *barrel and great wheel*, similar to that in the going train with the exception, that in the rim of the great wheel pins were fixed for lifting the hammer. The fall of the striking weight was nearly double that of the going, so that in winding, when the rope reached one end of the barrel it had to coil back again, thus forming *two* coils of rope upon the barrel. The great wheel acted into a pinion, on the arbor of which was a *contrate wheel*. This wheel worked into an upright pinion on which was the fly. The arbor of the great wheel projected beyond the outside of the frame, on which was a small pinion, this pinion drove the count wheel or locking plate, which hung upon a stud outside the frame. Two pins were fixed into the rim of the *going* great wheel (which revolved once in two hours) which lifted a lever for setting off the striking. As I before stated no file marks were visible in its construction not even in the wheels or pinions; the wheels were anything but circular; the teeth were either *punched out* or else had been *struck while hot with the claw or tail of a hammer*; the pinions had been made in the same way (the pinions were of four and six) while their arbors were of a shape perfectly indescribable, being neither square, round, or oval. The fly pinion was the most *unique* of all, the maker had evidently taken a square bar of iron, *punched it through at the centre at right angles, which being forced out formed a pinion of four teeth*, (this pinion was the *admiration* of all clockmakers who beheld it). As a set off to the *tripping* of the going train, the striking part very often kept on striking until run down. Many a complaint has been made against its vagaries in this respect, as the hammer struck upon one of the largest bells in Scotland, it was anything but agreeable to be awakened during the night, with it booming something like a funeral toll, but alas, it has had its day and is now numbered with the things of the past, what has become of it, I know not. But as a Horological curiosity, it was well worthy of preservation, and would form an interesting addition to the Museum of the Horological Institute. I look back to the days of my boyhood, when as an apprentice, I had the duty every other day of climbing a corkscrew staircase of 300 steps to wind up this antiquated machine, a duty I had to undertake even in the dark hours of a winter night, when it happened that a gale of wind had caused it to perform one of the vagaries referred to. These nocturnal visits have often compelled me to utter imprecations loud, and deep, against turret clocks, and this one in particular. Being in Dundee a short time ago and happening to be in the vicinity of the Auld Steeple, I cast my eyes towards where a huge square black board used to be seen, this board with its obliterated chapters and solitary hand, had been replaced with a modern dial on a part of which was the name Rattray, in large gilt letters; as there is a watchmaker in Dundee of that name, I concluded that he had supplied the new clock, therefore should any one be desirous of learning more regarding The Auld Steeple Clock, they will doubtless receive the required information from the party above referred to.

J. M.

EDINBURGH, *October* 1864.

[N.B.—An interesting communication from R. Webster, Esq., is in type, but owing to press of matter is unavoidably postponed to next month.]

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., SEPTEMBER, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12.)	At 9A.M.	During the next 24hours.
	Inches.	°	°	°	°				
1	30·101	57	54	67	48	WSW	3	bc	cb
2	29·914	60	58	67	51	W	5	c	op
3	·740	59	57	64	50	W	4	bc	bc, p
4	·858	60	57	68	51	W	4	bc	cb, r
5	·960	57	53	67	52	W	5	c	cb
6	30 062	59	56·5	66	49	WSW	4	r	rr, o
7	·008	64·5	63	70	53	W	2	o	o, m
8	·022	67	65	70	60	SW	5	o	oqp
9	29·972	66·5	64	73	62	SW	6	o	oq
10	30·059	58	55	68	52	W	2	o	o
11	29·832	54	51	62	48	W	4	bc	bc, b
12	30·043	48	46	61	42	WSW	3	b	bc, b
13	·013	57	53	62	46	W	2	m	c p b
14	29·752	61	58	62	52	WSW	3	o	o, rr
15	·665	58	55·5	64	47	WSW	3	o	bc, r
16	·267	50	50	64	47	SW	5	r	p, c, r
17	·477	56	54	62	47	WSW	6	bc	c, r
18	·666	52	50	65	50	WSW	3	b	bc, r
19	·738	52	49	65	48	W	3	b	b, o, c
20	·934	48	42	63	43	W	2	bc	o, r
21	·775	56	53	61	48	WNW	3	bc	cb
22	·802	57	55	66	54	SW	2	b	cb
23	30·028	53	51	66	49	W	3	b	bc, r
24	·103	59	56	63	53	W	4	o	bc
25	·352	53	51	64	45	WSW	2	bm	bc, m
26	·405	51·5	51	63	46	CALM	0	f	m, b
27	·331	53	50	62	45	ENE	3	b	bc
28	·315	51	50	63	44	E	1	b	bc
29	·233	52	50	65	47	W	3	b	bc
30	·163	55	53	63	48	E	2	bc	bc
	29 956	56.1	53·7	64·9	49·2	—	3.2	—	

REMARKS.

Rain fell on 12 days to the amount of 2·42 inches.

The winds blew from the W on 22 days, from the N, 1 day; from the E, 2 days; from the S, 4 days.

The weather was as nearly as possible similar to the normal values deduced from observations of former years in September.

The Weather and the Weight of the Human Body:—"The body is 1 lb. to 2 lbs heavier after a meal, 1 lb. to 2 lbs. lighter after egestion, 1 lb. to 2 lbs. heavier at night, and 1 lb. to 2 lbs. lighter after the night's absence of food. If the person perform much physical labour and live regularly during the week, and rest entirely on the Sunday, he is 1 lb. to 4 lbs. heavier on the Monday than on the Saturday. On the occurrence of a sudden thaw his hands swell, fluids are retained, and he becomes heavier, and on the sudden occurrence of a cold wind or a frost his egestion is increased and he becomes lighter. I have lost 4 lbs weight in one day from this cause alone. In spring a person gains, and in summer he loses weight. Such are natural variations in weight and it may be added that they are the most marked in persons given to obesity." F.R.S, *vide* "Times."

EQUATION OF TIME TABLE

FOR NOVEMBER, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon. — Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At Mean Noon. — Equation of Time to be *added* to Mean Time.
		m. s.	.	m. s.
Tues...	1	16 18·19	0·035	16 18.20
Wed ..	2	16 18·64	0·002	16 18.64
Thurs .	3	16 18·28	0·032	16 18.27
Fri....	4	16 17·11	0·065	16 17.09
Sat....	5	16 15·14	0·099	16 15.11
Sun ...	6	16 12·35	0·133	16 12.31
Mon ..	7	16 8·76	0·167	16 8.71
Tues...	8	16 4·33	0·201	16 4.28
Wed ..	9	15 59·10	0·236	15 59.04
Thurs .	10	15 53·02	0·270	15 52.95
Fri....	11	15 46·13	0·305	15 46.05
Sat....	12	15 38·38	0·340	15 38.29
Sun ...	13	15 29·80	0·375	15 29.70
Mon ..	14	15 20·36	0·411	15 20.25
Tues...	15	15 10·07	0·447	15 9.96
Wed ..	16	14 58·93	0·482	14 58.81
Thurs .	17	14 46·95	0·517	14 46.82
Fri....	18	14 34·10	0·552	14 33.97
Sat....	19	14 20·44	0·587	14 20.30
Sun ..	20	14 5·95	0·622	14 5.80
Mon ..	21	13 50·60	0·656	13 50.45
Tues...	22	13 34·47	0·690	13 34.31
Wed ..	23	13 17·52	0·723	13 17.36
Thurs .	24	12 59·78	0·755	12 59.62
Fri....	25	12 41·29	0·787	12 41.12
Sat....	26	12 22·01	0·818	12 21.84
Sun ...	27	12 2·00	0·849	12 1.83
Mon ..	28	11 41·27	0·879	11 41.10
Tues...	29	11 19·83	0·907	11 19.66
Wed ..	30	10 57·72	0·934	10 57.55

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COVENTRY WATCHMAKERS' ASSOCIATION.

On Monday evening the 6th annual meeting of this Association was held at St. Mary's Hall. There was only some 40 or 50 persons present.

Mr. W. TRICKETT was voted to the chair, and said he was sorry he could not congratulate them on having a large meeting. He thought that the matters to be brought before them would have induced a greater number to attend. He would, however, call upon the secretary to read the report.

Mr. SHUFFLEBOTHAM then read as follows:—

"The Committee of the Coventry Watchmakers' Association, in presenting their sixth annual report, are glad to say that the improvement of the trade, referred to in their last report, has been maintained through the whole of the year, indicating a steadiness in the demand for English watches, notwithstanding the large importations. This improvement has had, we are also glad to say, some effect in raising the value of labour, in some instances 10 per cent., and we think such would have been the case almost universally had our recommendation in the handbill issued some time since been more generally followed by the workmen employed in the different shops. We are assured, however, that by individual action alone prices must improve if the demand increases. It was this conviction which induced us to issue the handbill above referred to. It must not be inferred from this, however, that we are the advocates of low wages, or that we wish in bad times for men to accept whatever is offered to them in the shape of remuneration, but we know it would be impossible for us to prevent wages from falling during times of bad trade, and we also know, from later experience, that without any effort of ours wages will improve as the demand improves. It may then fairly be asked what is the use of the association if it cannot protect wages — the principal object for which it was established? We answer that there are many ways in which an association can be useful to a trade like the watch trade, without interfering at all with the question of wages. One of these is by getting reliable statistics of the trade. It will be remembered that an endeavour was made by us just previous to the last annual meeting to ascertain how many watch cases had been assayed and marked at the different offices in the united kingdom for the then last three years. Finding, however, that we could not obtain full returns from Goldsmith's Hall, except by an order from the House of Commons, we applied to Sir J. Paxton, by whose valuable help we have now complete returns from all the offices for the last fourteen years, and also the number of watches imported during the same period. Thinking it would be desirable that some abridgement of these returns should be printed in a convenient form for reference and comparison, our former Secretary prepared one, which appeared in the Coventry papers, copies of which have been reprinted and circulated among the subscribers and others. Another way in which an association like this could be useful to the trade, would be in forming a library of books on watches and watchmaking and scientific subjects generally, and by getting together a collection of models and diagrams of new and improved tools, escapements, and specimens of good workmanship, and a reading room, where these could be kept for reference and examination, and where during the winter season occasional lectures or readings could be given with oral instruction on the principles of watch and clock making. Now, although this would not protect wages in the ordinary acceptation of those words, yet it might enable many workmen to obtain higher wages, by giving them a more intimate knowledge of their business. It would also show that we are fully alive to the importance of united action in furthering that improvement, which must mainly depend on individual effort. It is known to many that during the late depression numbers of workmen left the town, rather than accept the prices offered, to go to watch jobbing shops, and thus relieved the trade of some of its surplus labour; and if a larger number would make themselves acquainted with various escapements, and the construction of clocks, employment would be obtained by them at good wages in all states of the trade, as we are informed there is a constant demand for such workmen. If such a room existed as we have indicated,

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it would be a great assistance to these and to all engaged in the trade, whether employers or workmen. We stated in our last report we had commenced forming a library. Since that time, by the application of our former Secretary, Mr. William May, (whom we are sorry was compelled to resign his office through continued ill-health,) we have obtained from the Patent Office full specifications of clocks and watches from 1661 to 1863. These we have bound in twelve vols., and should have had them ready for circulation, ere this, with the volumes of the "Horological Journal" we have, had we not thought it possible to form with the co-operation of the manufacturers an Institute or Reading-room, where they could be placed with other appropriate works for reading and reference. It will be remembered that the watch manufacturers of Coventry, at the suggestion of your committee, offered a prize of £20 for an essay for learners, to which was added a second prize of £5 by the association. Though this was fully advertised but two essays were sent in, neither of which were deemed by the adjudicators to possess sufficient merit to form a text book for learners, and so the prizes were withheld. At the first meeting of manufacturers called to hear the report of the said adjudicators and dispose of the money in hand, no conclusion was come to on this latter point, but at the next meeting a resolution was passed, that a meeting should be specially called to consider the question of founding an Institute for the instruction of persons engaged in the trade, and as your committee had long desired to see such an Institute established, they agreed unanimously to pass the following resolution, subsequent to the manufacturers' meeting:—

'We, the Committee of the Coventry Watchmakers' Association, having heard through our representative at the manufacturers' prize fund meeting, held in the Justice room, June 21st, that it was determined to call the next meeting to consider the advisability of forming an institute for the instruction of watchmakers in matters relating to their trade, hereby express our willingness to co-operate in so good a work, and will use our endeavours to obtain from the subscribers to the funds of the association, permission to appropriate a portion of those funds to help in the formation of such an institute.'

'Signed on behalf of the committee,
J. Bales, *chairman.*

'Committee-room, Rose Inn, Moat-street, Aug. 10, 1864.'

"This having been communicated to the subscribers to the prize fund, with the circular calling their final meeting, no doubt contributed in some measure to induce them to come to the following determination with respect to the disposal of the £20 and odd which remained after defraying the expenses of advertising, &c.:—'Resolved,—That the Watchmakers' Association be requested to form a Working Man's Club for the watchmakers of Coventry, and that the money in hand be placed in the bank, in the names of Messrs. Wootton and Rotherham, till such a club be established on a satisfactory basis, when it shall be handed over to the club for the foundation of a library or some kindred purpose.'

"It now remains for the present meeting to determine whether a portion of the funds of the Association shall be devoted to the opening and furnishing of such a club. If you determine to do so we have no doubt from the tone prevalent at the meetings of manufacturers, that they will co-operate in the effort to make it successful by becoming honorary subscribers. We have purposely invited all who have at any time contributed towards the fund, as such appropriation was considered somewhat foreign to the original purpose of the association, and also with the hope that if you think with us you will join heart and hand and make it a success. A resolution will be submitted in reference to this matter. The following persons retire from office, but are eligible for re-election, viz.:—J. Overton, W. Clarke, R. Tatlow, J. Bales, C. Frearson, R. Watson, and — Bacon."

The Balance Sheet for the two years, ending September 30, 1864, *showed*:—

	£.	s.	d.
In Bank..	159	0	4
Receipts	26	11	10
	185	12	2
Disbursements	26	0	5
In hand	159	11	9

Mr. Bales moved that the report be adopted. He said it was a matter of congratulation that they stood in a better position, as far as trade matters went, than they had done recently. There had not been such a great demand for watches as there had been in former times, but still it had been a steady demand, and was therefore to be preferred to the greater demand which might not last. Mr. Bales then entered into a long

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statement as to the original intention of the Watchmakers' Association, and explained that although it had not been able to influence wages, yet it might still bring good to the trade. He then said that what the society had failed to do directly, it might accomplish indirectly, by forming an institute at which lectures might be given, and at which parts or portions of watches might be exhibited to those who attended, and thus lead to an improved state of things, as regarded a practical knowledge of the watch trade. He concluded by an earnest exhortation to young men to use all means to understand their particular business, and suggested that by establishing a club they would be materially assisting in spreading knowledge.

Some one in the room seconded the proposition, which was carried.

Mr. DEWIS contrasted the appearance of that, their 6th annual meeting, with the one first held in that room, and which was a crowded one. The reason the watchmakers had subscribed to the association was because they thought by paying a penny a week they would get back a shilling on a watch, or three shillings a week. At one time the association reached 600 members, but as time passed and wages grew no higher, the popularity of the association fell away. Still they had about £160 in hand, and if they did not now avail themselves of the opportunity offered to establish a club with a portion of that money, they might never have the opportunity again. He begged to move that the committee be empowered to appropriate a portion of the funds of the association to the formation of a working man's club, to be called the Coventry Watchmakers' Association and Institute, on condition that 200 persons enrol their names as members.

This was seconded.

Mr. LEE suggested that the sum set aside for the purpose should be £20, which, with the manufacturers' £20, would be £40.

It was, however, decided to leave the money question open till it was seen whether the attempt to obtain the requisite number of names was successful.

The resolution was accordingly put and passed, Mr. Shufflebotham stating his willingness to receive the names of any persons anxious to take part in the formation of the club.

A young man in the room stated that the society had in one instance to his knowledge prevented a decline in wages. A deputation having waited on a firm of manufacturers who had taken a shilling off "the jewelling," remonstrated with them, and on being told that they were the first who had lowered the price they agreed to raise it again, which they did. Had that decline continued it would soon have become general in the trade.

Mr. BAND stated that at the late essay competition, although only two persons had competed, and the essays were not considered sufficiently good, yet there had been three meetings of the adjudicators with respect to one of those essays before they finally decided, and that was some proof of its merit. That essay was written by a member of their association, and by one of the committee of that association. Mr. Band then called attention to the proposition mentioned in the notice convening the meeting, relative to the setting apart of a fund for pensioning aged workmen. He suggested that £100 should be set aside to form a Coventry Aged Watchmaker's Pension or Provident Fund, and by paying subscriptions to it for about eight years, they might be able to effectually relieve aged workmen either on the seniority or election principle. He mentioned that Mr. Lee was the originator of the idea.

This matter was referred to a committee consisting of Messrs. J. Lee, T. Shufflebotham, Dewis, Clarke, Bales, and H. Band.

The committee elected in the place of those who retire were Messrs. W. Carter, Stanley, C. Frearson, Bales, G. Cooke, and Watson.

Votes of thanks to the chairman for presiding, and the Mayor, for allowing the use of the Hall, were then passed, and the proceedings terminated.

THE BELFRY OF BRUGES.—The belfry tower in the Grande Place of Bruges, the chief town of Western Flanders, is ascended by four hundred and two steps, and affords a most extensive view of the surrounding country, which is remarkable for its flatness; and is worthy of a visit on account of its celebrated chime bells, which are said to be the finest in Europe. These bells, forty-eight in number, (some of them being of huge dimensions,) are struck by one hundred and forty hammers, which are worked by a curious system of machinery, and are made to chime every quarter of an hour, producing notes, that are most agreeable from the sweetness and richness of their tones.—*Dublin Journal of Science*, vol. ii.

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NAME OF MAKER.	No.	Whether Pocket, 2 or 8 Days.	ADDRESS OF MAKER.	Construction of Escapement and Balance, from the Description furnished by the Maker.
Kullberg . . .	760	8	12, Cloudesley Terrace, Islington London.	Kullberg's flat rim balance without auxiliary.
McGregor and Co. .	3335	2	38, Clyde-place, Glasgow.	Poole's auxiliary.
Millidge and Son .	397	2	28, Princess-street, Edinburgh.	Auxiliary compensation.
C.M.Frodsham, jun	4 3348	2	84, Strand, London.	New auxiliary acting at all temperatures.
Hennessy. . . .	3265	2	5, Wind-street, Swansea.	Poole's auxiliary.
Cairns.	786	2	13, Waterloo-road, Liverpool.	Poole's auxiliary.
Muirhead and Son.	3677	2	90, Buchanan-street, Glasgow.	Poole's auxiliary.
Webb	5443	2	4, Pullen's-row, Islington, London.	Auxiliary as in former years.
Lister and Sons. .	598	2	Newcastle-upon-Tyne.	Poole's auxiliary.
McGregor and Co. .	2846	2	38, Clyde-place, Glasgow.	Auxiliary compensation.
P. Birchall . . .	841	2	65, Great Percy-street, London.	Ordinary balance with slight alteration.
Reid and Sons . .	1243	2	41, Grey-street, Newcastle-upon-Tyne.	Auxiliary to balance.
Hennessy. . . .	3264	2	5, Wind-street, Swansea.	Poole's auxiliary.
Lister and Sons. .	608	2	Newcastle-upon-Tyne.	Poole's auxiliary.
Glover	330	2	4, Swinton-street, Gray's-Inn-road, London.	Auxiliary compensation acting in cold.
Poole	3337	2	57, Fenchurch-street, London.	Poole's auxiliary.
Dent	3009	2	61, Strand, London.	Dent's patent balance.
Dent	23153	2	33, Cockspur-street, London.	Auxiliary compensation.
Reid and Sons . .	1228	2	41, Grey-street, Newcastle-upon-Tyne.	Auxiliary to balance.
Dobbie	3715	2	24, Clyde-place, Glasgow.	Poole's auxiliary.
Cairns.	789	2	13, Waterloo-road, Liverpool.	Poole's auxiliary.
Pickford	5990	2	Liverpool.	Auxiliary compensation.
Porthouse & French	7223	2	16, Northampton-sq., Goswell-road, London.	Original auxiliary
T. Campbell. . .	946	2	7, South Castle-Street, Liverpool.	Ordinary balance, with slight alteration.
J. B. Fletcher . .	2972	2	148, Leadenhall-street, London.	Auxiliary compensation.
W. P. Birchall . .	11	2	65, Great Percy-street, London.	Ordinary balance, with slight alteration.
Clark and Son . .	3398	2	Greenock.	Poole's auxiliary.
Eiffe	562	2	2, Orange-street, Red Lion-sq., London.	Auxiliary compensation to pendulum spring.
Parkinson & Bouts	1127	2	59, Gracechurch-street, London.	Ordinary construction.
Blackie	655	2	24, Amwell-street, Clerkenwell, London.	[No information received].

* During these weeks the North windows of the Chronometer Rooms were left open.

† During these weeks the Chronometers were placed in the chamber of a stove heated by jets of gas. The gas flames are exterior to the chamber, into which none of the injurious products of combustion can enter.

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ABSTRACT OF THE PRINCIPAL CHANGES OF RATE.

First Day of First week of Rating.	Last Day of Last Week of Rating.	No. of Weeks.	Least Weekly Sum.	In what Week.	Greatest Weekly Sum.	In what Week.	Difference between the Greatest and Least.	Greatest Difference between one Week and the next.	Before and after what Day.
			s		s		s	s	
Jan. 9	July 23	28	− 3.6	Jan. 30 to Feb. 6*	+ 7.6	May 28 to June 4†	11·2	8.7	† June 25
Jan. 9	July 23	28	− 2.2	March 19 to 26†	+ 8.2	January 9 to 16*	10·4	5.5	* Jan. 23*
Jan. 9	July 23	28	−18.6	March 19 to 26†	− 7·3	January 23 to 30*	11·3	5.9	Mar.19†
Jan. 9	July 23	28	− 4.0	January 9 to 16*	+ 5·4	July 2 to 9	9·4	6.9	Apr. 30
Jan. 9	July 23	28	− 0.8	Feb. 27 to March 5*	+12·6	July 2 to 9	13·4	5.5	† June 25
Jan. 9	July 23	28	+ 6.7	April 2 to 9†	+16·4	July 16 to 23	9·7	7·6	† June 25
Jan. 9	July 23	28	+ 3.6	March 19 to 26†	+19·6	July 16 to 23	16·0	5·4	† June 4†
Jan. 9	July 23	28	− 3.5	January 16 to 23*	+ 9·4	June 11 to 18†	12·9	7.2	May 28†
Jan. 9	July 23	28	− 1.3	March 19 to 26†	+13·4	May 7 to 14	14·7	6·6	May 14
Jan. 9	July 23	28	− 8.7	March 19 to 26†	+ 8·8	July 2 to 9	17·5	5·6	* Feb. 27*
Jan. 9	July 23	28	+ 1.0	March 19 to 26†	+14·5	June 18 to 25†	13·5	8·4	† June 25
Jan. 9	July 23	28	− 0.1	Jan. 30 to Feb. 6*	+19.7	July 16 to 23	19·8	7·3	May 28†
Jan. 9	July 23	28	− 9.5	June 18 to 25†	+ 3·9	February 6 to 13*	13·4	10·6	* Feb. 27*
Jan. 9	July 23	28	+ 1.3	June 18 to 25†	+15·5	February 20 to 27*	14·2	10·3	† June 4†
Jan. 9	July 23	28	+15.1	January 9 to 16*	+34·6	July 16 to 23	19·5	7·7	Mar.19†
Jan. 9	July 23	28	+ 1.1	January 23 to 30*	+15·8	April 23 to 30	14·7	10·1	† June 25
Jan. 9	July 23	28	−25.8	March 26 to April 2†	− 8·1	July 2 to 9	17·7	9·1	† April 16
Jan. 9	July 23	28	−14.7	June 4 to 11† June 11 to 18†	+ 1·0	{Mar. 26 to April 2† / April 23 to 30}	15·7	11·2	† June 4†
Jan. 9	Jnly 23	28	− 6.6	March 12 to 19	+13·8	June 4 to 11† June 11 to 18†	20·4	9·0	May 28†
Jan. 9	July 23	28	− 0.5	February 20 to 27*	+26·7	July 16 to 23	27·2	6·4	* Feb. 20*
Jan. 9	July 23	28	+ 1.0	January 23 to 30*	+29·8	July 16 to 23	28·8	6·3	May 28†
Jan. 9	July 23	28	−18.9	March 19 to 26†	+ 6·5	July 16 to 23	25·4	8·2	Mar.19†
Jan. 9	July 23	28	−13.2	June 18 to 25†	+ 7·0	February 20 to 27*	20·2	11·1	† June 4†
Jan. 9	July 23	28	+ 8.9	March 19 to 26†	+30·1	June 11 to 18†	21·2	11·1	† April 2†
Jan. 9	July 23	28	− 3.7	February 20 to 27*	+23·3	June 11 to 18†	27·0	8·3	July 9
Jan. 9	July 23	28	−30.1	March 19 to 26†	− 6·7	June 25 to July 2	23·4	10.4	{†Mar. 26† / May 14.}
Jan. 9	July 23	28	− 5.1	Feb. 27 to March 5*	+14·7	{July 9 to 16; / July 16 to 23}	19·8	12.2	* March 5
Jan. 9	July 23	28	−43.1	January 23 to 30*	−20·0	July 16 to 23	23·1	11.3	May 28†
Jan. 9	July 23	28	−13.0	February 20 to 27*	+ 5·0	June 25 to July 2	18·0	16.4	† June 25
Jan. 9	July 33	28	+10.0	March 26 to April 2†	+29·6	February 20 to 27*	19·6	15·7	* Feb. 27*

The order of arrangement of the Chronometers in this Table is determined solely by consideration of their irregularities of rate.

The Chronometer Marshall 2000 was found stopped on June 25, and was returned to the maker on July 11. Dent 2308 became deranged after May 4, and was returned to the maker on May 23. On account of the shorter duration of trial, the rates of these Chronometers are not comparable with those of the other Chronometers, and they are in consequence placed in a separate division at the end of the general Table.

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NAME OF MAKER.	No.	Whether Pocket, 2 or 8 Days.	ADDRESS OF MAKER.	Construction of Escapement and Balance, from the Description furnished by the Maker.
C. Frodsham. . .	3155	2	84, Strand, London.	Auxiliary for mean and extremes of cold.
F. Fletcher . . .	2913	2	148, Leadenhall-street, London.	Auxiliary compensation.
J. Campbell . . .	945	2	7, South Castle-street, Liverpool.	Ordinary balance, with slight alteration.
Carter	708	2	61, Cornhill, London.	Ordinary construction.
Parkinson & Frodsham	3474	2	4, Change-alley, Cornhill, London.	Auxiliary to ordinary balance.
Gowland	2693	2	Sunderland.	Auxiliary compensation.
Parkinson & Bouts	1094	2	59, Gracechurch-street, London.	Ordinary balance, with slight alteration.
Parkinson & Frodsham	3701	2	4, Change-alley, Cornhill, London.	Auxiliary to ordinary balance.
Blackie	657	2	24, Amwell-street, Clerkenwell, London.	[No information received].
Jürgensen . . .	LII.	2	Copenhagen.	New escapement for diminishing friction, ordinary balance.
J. Fletcher . . .	2818	2	148, Leadenhall-street, London.	Auxiliary compensation.
Sewill	2001	2	61, South Castle-street, Liverpool.	Auxiliary acting in extremes of temperature.
Webb	5383	2	4, Pullen's-row, Islington.	Auxiliary as in former years.
Dent	3048	2	61, Strand, London.	Auxiliary compensation.
Glover.	331	2	4, Swinton-street, Gray's-Inn-road, London,	Auxiliary compensation acting in cold.
Poole	3343	2	57, Fenchurch-street, London.	Poole's auxiliary.
J. Fletcher . . .	2933	2	148, Leadenhall-street, London.	Auxiliary compensation.
Roskell	1762 / 66735	2	21 & 23, Church-st., Liverpool.	Molyneux's auxiliary.
Carter.	692	2	61, Cornhill, London.	Auxiliary compensation.
Crisp	380	2	81, St. John's-street-road, London.	Auxiliary acting in high temperatures.
Birch	512	2	173, Fenchurch-street, London.	Double auxiliary.
Hutton	554	P	10, Mark-lane, London.	Auxiliary to spring, for extreme heat only.
Highfield. . . .	5899	2	5, King Edward-ter., Liverpool Road, London.	Ordinary balance.
Jürgensen . . .	XXII.	2	Copenhagen.	New escapement for diminishing friction, ordinary balance.
Birch	1350	2	173, Fenchurch-street, London.	Ordinary construction.
Marshall	2000	2	5, King-square, London.	Mercurial auxiliary to balance.
Dent	23084	2	33, Cockspur-street, London.	Auxiliary compensation.

* During these weeks the North windows of the Chronometer Room were left open.

† During these weeks the Chronometers were placed in the chamber of a stove heated by jets of gas. The gas flames are exterior to the chamber, into which none of the injurious products of combustion can enter.

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ABSTRACT OF THE PRINCIPAL CHANGES OF RATE.

First Day of First Week of Rating.	Last Day of Last Week of Rating.	No. of Weeks.	Least Weekly Sum.	In what Week.	Greatest Weekly Sum.	In what Week.	Difference between the Greatest and Least.	Greatest Difference between one Week and the next.	Before and after what Day.
			s		s		s	s	
Jan. 9	July 23	28	−15.9	March 26 to April 2†	+ 2·4	March 12 to 19	18·3	16.4	Mar.19†
Jan. 9	July 23	28	−14.0	February 20 to 27*	+16·9	June 25 to July 2	30·9	10·3	† April 9†
Jan. 9	July 23	28	− 7.0	Feb. 20 to 27* April 9 to 16†	+13·2	May 7 to 14	20·2	15·7	† April 16
Jan. 9	July 23	28	+ 4.7	Feb. 27 to March 5*	+42·3	July 16 to 23	37·6	8·0	Mar.19†
Jan. 9	July 23	28	−11.6	June 11 to 18†	+23·7	February 13 to 20*	35·3	9·9	† April 2†
Jan. 9	July 23	28	−26.5	March 19 to 26†	− 0·7	June 18 to 25†	25·8	14·9	† June 25
Jan. 9	July 23	28	−38.4	February 20 to 27*	+14·6	May 7 to 14; May 21 to 28	23·8	17.3	† June 4†
Jan. 9	July 23	28	+ 6.0	May 14 to 21	+27·1	June 18 to 25†	21·1	19·3	† June 4†
Jan. 9	July 23	28	+ 8.1	January 9 to 16*	+42·1	May 7 to 14	34·0	13·0	July 2
Jan. 9	July 23	28	−25.3	February 20 to 27*	+ 1·0	May 28 to June 4†	26·3	17.5	† April 9†
Jan. 9	July 23	28	−25.0	February 20 to 27*	+11·6	July 16 to 23	36·6	12·8	Mar.19†
Jan. 9	July 23	28	− 4.6	June 4 to 11†	+24·5	June 25 to July 2	29·1	20·5	† June 25
Jan. 9	July 23	28	−21.3	February 20 to 27*	+20·8	June 25 to July 2	42·1	16.9	† June 25
Jan. 9	July 23	28	−27.6	March 26 to April 2†	+13·9	June 11 to 18†	41·5	17·6	Mar.19†
Jan. 9	July 23	28	+ 0.4	January 9 to 16*	+50·5	July 16 to 23	50·1	13·4	† June 25
Jan. 9	July 23	28	− 5.0	June 11 to 18†	+23·4	July 2 to 9	28·4	25·8	† June 25
Jan. 9	July 23	28	− 4.7	March 12 to 19	+34·5	July 2 to 9	39·2	21·5	Mar.19†
Jan. 9	July 23	28	−15.1	July 16 to 23	+14·6	June 4 to 11†	29·7	28·8	† June 4†
Jan. 9	Jnly 23	28	−20.0	June 4 to 11†	+14·4	June 25 to July 2	34·4	28·6	† June 25
Jan. 9	July 23	28	−21.4	June 4 to 11†	+33.0	July 16 to 23	54·4	21·2	† June 25
Jan. 9	July 23	28	− 8.5	January 9 to 16*	+78.6	July 16 to 23	87·1	13·4	Mar.19†
Jan. 9	July 23	28	+11.8	April 2 to 9†	+66·7	May 14 to 21	54·9	37·2	† Apr. 16
Jan. 9	July 23	28	+ 2.6	January 16 to 23*	+ 82·6	July 2 to 9	80·0	36·9	† June 25
Jan. 9	July 23	28	−33.6	March 12 to 19	+30·5	February 20 to 27*	64·1	60·5	* Feb. 27*
Jan. 9	July 23	28	−94.4	June 4 to 11†	+71·9	March 12 to 19	166·3	96·4	† June 4†
Jan. 9	June 18	23	− 1.2	February 20 to 27*	+29·2	May 28 to June 4†	30·4	7·1	†Mar. 26†
Jan. 9	April 30	16	−11.0	Jan. 30 to Feb. 6*	+ 7·6	February 20 to 27*	18·6	17·4	* Feb. 6 *

The order of arrangement of the Chronometers in this Table is determined solely by consideration of their irregularities of rate.

The Chronometer Marshall 2000 was found stopped on June 25, and was returned to the maker on July 11. Dent 23084 became deranged after May 4, and was returned to the maker on May 23. On account of the shorter duration of trial, the rates of these Chronometers are not comparable with those of the other Chronometers, and they are in consequence placed in a separate division at the end of the general Table.

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EDINBURGH HOROLOGICAL SOCIETY.

THE EDINBURGH HOROLOGICAL SOCIETY held their Fifth Half-yearly Meeting in the Society's Room, *Goldsmiths' Hall*, on the evening of the 2nd. November;

Mr. J. MORE, *President*, in the chair.

Mr. BAIRD read an excellent paper entitled Steam Printing and Telegraph Reporting; at the conclusion of which a vote of thanks was accorded to him by the members.

The *Secretary*, Mr. J. MCKAY then read a report of the Society's proceedings during the past six months, and shewed that the Society was steadily increasing, and that many bore testimony to the good results that had sprung from it. The following is a syllabus of the papers read during the past session:—Morton's Patent Chronometer, by Mr. Donald; the Training of Apprentices, by Mr. McKay; Phillips's Invention by Mr. More; The Process of Watch Manufacture, by Mr. Brown; Clock Work, by Mr. Falconer; Time, by Mr. Spence.

The *Treasurer*, Mr. DONALD, then gave a report of the financial state of the Society, and showed a large surplus fund in hand.

Mr. MEEK, *Librarian*, gave a statement of the condition of the Library which shewed it to be steadily increasing.

The Reports were unanimously adopted by a large attendance of members.

The following is the list of Office Bearers elected for the next six months.

President, Mr. MORE,
Vice President, Mr. SPENCE,
Secretary, Mr. McKay,
Treasurer, Mr. Donald.

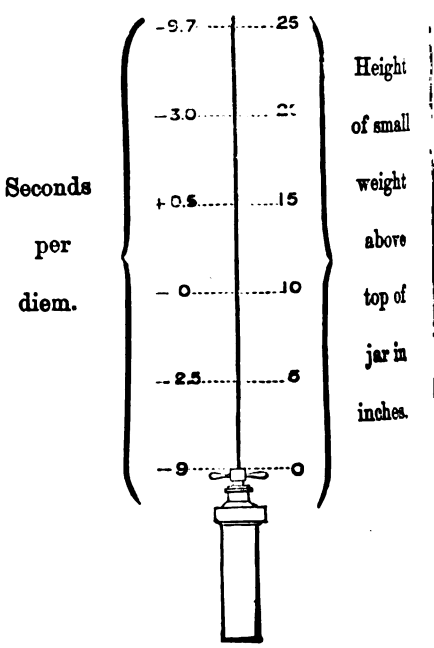
Committee.

Messrs. FALCONER, CAMPBELL, INCHES ADAIR, THOMSON, AND MEEK.

CORRESPONDENCE.

To the Editor of the Horological Journal.

Sir,—Many astronomical clocks are made with a small weight sliding on the pendulum rod. After the clock has been brought as nearly to time as possible by the screw, this auxiliary sliding weight is intended to be moved up or down, in order to bring the clock nearer to a mean rate than would be convenient with the screw; moreover, it possesses the advantage of being able to be moved by the gentle tap of a hammer, without stopping the pendulum. I now wish to point out a fact, which although familiar to those who have mathematically studied the laws of the pendulum, may perhaps not be so generally known to clockmakers, viz., that if the clock be going correctly with the sliding weight in the middle of the rod, whether this weight be moved up or down, the clock will lose. The following table shows the results of trials on this subject, the figures on one side of the pendulum indicating the position of the weight, and on the other the corresponding rate.



From the above it will be noticed that any sliding up or down of the small weight about the middle of the pendulum, has scarcely any effect upon the time, also, if the clock have a losing rate, and the weight be equidistant from the points of suspension, and centre of oscillation, this weight will be useless, because whether it be moved up or down, the clock will lose more. It is therefore advisable, if a sliding weight be applied, to bring the clock to a gaining rate before making use of it. The clock may then be brought to a mean rate, if the small weight be in the middle of the radius of oscillation by sliding it either up or down, but the latter is preferable. I am, Sir, your obedient servant,

R. WEBSTER.

74, Cornhill.

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SIR C. LYELL ON THE NEW METALS.

Professor Roscoe, of Manchester, has been lately engaged in making a careful analysis of the Bath waters, and has discovered in them three metals which they were not previously known to contain—namely, copper, strontium, and lithium; but he has searched in vain for cæsium and rubidium, those new metals, the existence of which has been revealed to us in the course of the last few years by what is called spectrum analysis. By this new method the presence of infinitesimal quantities, such as would have wholly escaped detection by ordinary tests, are made known to the eye by the agency of light. Thus, for example, a solid substance such as the residue obtained by evaporation from a mineral water, is introduced on a platinum wire into a colourless gas-flame. The substance thus volatilized imparts its colour to the flame, and the light, being then made to pass through a prism, is viewed through a small telescope or spectroscope, as it is called, by the aid of which one or more bright lines or bands are seen in the spectrum, which, according to their position, number, and colour, indicate the presence of different elementary bodies. Professor Bunsen, of Heidelburg, led the way, in 1860, in the application of this new test to the hot waters of Baden-Baden, and of Dürkheim, in the Palatinate. He observed in the spectrum some coloured lines of which he could not interpret the meaning, and was determined not to rest till he had found out what they meant. This was no easy task, for it was necessary to evaporate 50 tons of water to obtain 200 grains of what proved to be two new metals. Taken together, their proportion to the water was only as one to three million. He named the first cæsium, from the bluish-gray lines which it presented in the spectrum; and the second rubidium, from its two red lines. Since these successful experiments were made, thallium, so called from its green line, was discovered in 1861 by Mr. Crookes; and a fourth metal named indium, from its indigo-coloured band, was detected by Professor Richter, of Freiberg in Saxony, in a zinc ore of the Hartz. It is impossible not to suspect that the wonderful efficacy of some mineral springs, both cold and thermal, in curing diseases, which no artificially prepared waters have as yet been able to rival, may be connected with the presence of one or more of these elementary bodies previously unknown, and some of the newly-found ingredients, when procured in larger quantities, may furnish medical science with means of combating diseases which have hitherto baffled all human skill. While I was pursuing my inquiries respecting the Bath waters, I learnt casually that a hot spring had been discovered at a great depth in a copper-mine near Redruth in Cornwall, having about as high a temperature as that of the Bath waters, and of which, strange to say, no account has yet been published. It seems that in the year 1839 a level was driven from an old shaft, so as to intersect a rich copper mine at the depth of 1,350 feet from the surface. This lode or metalliferous fissure occurred in what were formerly called the United Mines, and which have since been named the Clifford Amalgamated Mines. Through the contents of the lode a powerful spring of hot water was observed to rise, which has continued to flow with undiminished strength ever since. At my request, Mr. Horton Davey, of Redruth, had the kindness to send up to London many gallons of this water, which have been analyzed by Professor Miller, F.R.S., who finds that the quantity of solid matter is so great as to exceed by more than four times the proportion of that yielded by the Bath waters. Its composition is also in many respects very different; for it contains but little sulphate of lime, and is almost free from the salts of magnesium. It is rich in the chlorides of calcium and sodium, and it contains one of the new metals cæsium, never before detected in

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any mineral spring in England; but its peculiar characteristic is the extraordinary abundance of lithium, of which a mere trace had been found by Professor Roscoe in the Bath waters; whereas in this Cornish hot spring this metal constitutes no less than a 26th part of the whole of the solid contents, which, as before stated, are so voluminous. When Professor Miller exposed some of these contents to the test of spectrum analysis, he gave an opportunity of seeing the beautiful bright crimson line which the lithium produces in the spectrum. Lithium was first made known in 1817 by Arfvedsen, who extracted it from petalite, and it was believed to be extremely rare, until Bunsen and Kirchhoff, in 1860, by means of spectrum analysis, showed that it was a most widely diffused substance, existing in minute quantities in almost all mineral waters and in the sea, as well as in milk, human blood, and the ashes of some plants. It has already been used in medicine, and we may therefore hope that, now that it is obtainable in large quantities, and at a much cheaper rate than before the Wheal Clifford hot spring was analyzed, it may become of high value.—*From the Address to the British Association, at Bath*, 1864.

THE FRENCH WATCH TRADE.

The manufacture of clocks and watches has made extraordinary progress in France of late years, particularly at Besançon, which town now competes successfully with Geneva for excellence of work. The manufactory of clocks and watches was established at Besançon in the year II. of the Great Republic, by Swiss emigrants, at a period of great difficulty, and in the midst of domestic troubles.

In 1845 the number of watches manufactured was only 54,192, of which 8,693 were gold. In 1853 the number increased to 94,897, of which 29,742 were gold. In 1854 the number of watches manufactured exceeded 100,000, and it has progressively increased every year since. In 1861 the number of watches manufactured amounted to 250,467, of which 83,678 were gold; in 1862 to 254,477, of which 87,966 were gold; in 1863 to 298,741, of which 109,078 were gold, comprising 1,647 stamp for exportation. In comparing the manufacture of watches at Besançon with that of all the other towns in France it will be found that in the year 1863 Besançon produced 298,741 watches, while all the other towns in France supplied only 8,186. Taking another view, and comparing the number of watches manufactured in Besançon with that produced in the rest of France, it will be seen that the manufacture of watches in other towns, taken altogether, has diminished by more than 4,000, while the manufacture of watches in Besançon increased by more than 48,000. It is believed that the export of watches from Besançon could be greatly increased were there a sufficient number of skilled workmen to be procured. Unfortunately, there is not, and to supply the deficiency the Municipal Council of Besançon have founded a school where good workmen are trained. The school is prosperous, but there is a want of a sufficient number of professors. The Municipal Council has demanded an annual grant of 8000*fr.* from the Government in order to increase the pay of the professors, and thus render their position more attractive.

NOTICE.—A Public Meeting of Watchmakers and Jewellers was held at the Institute, on the 24th ult., Richard Webster, Esq. in the chair, to take into consideration the propriety of addressing the Goldsmiths' Hall, as to the injurious treatment of the Work sent to them for Assaying and Stamping, and their excessive charge for the same. A deputation was appointed to obtain an interview with the Court of the Goldsmiths' Company.

A full report of the Meeting will appear in our next Journal.—[ED. H. J.]

ABRIDGEMENTS OF SPECIFICATIONS OF PATENTS

RELATING TO WATCHES, CLOCKS, AND OTHER TIMEKEEPERS.

1853, January 26.—No. 199.

NOLET, CHARLES.—*Void by reason of notice to proceed not having been given within the time prescribed by the Act.* The provisional specification states that "This invention consists in the application of electric currents, which are alternately broken and established by a prime regulating time

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keeper, for the actuating of any number of separate time keepers, for the purpose of indicating the correct time in various parts of a town or building simultaneously. This is effected in the following manner:—a battery is placed in connection with a regulating clock or chronometer, and the current passes through it to a series of other time indicators by wires laid down for the purpose. These latter indicators may be constructed in and fitted to the ordinary street lamps, the dials being formed on the sides of the lamps, which may be of ground glass, so that the time may be easily read off either at night or during the day. The mechanism for actuating the hands of the various time indicators consists simply of the ordinary dial wheels of a clock, for giving the two speeds required for the hour and minute hand, and a ratchet wheel and palls. The palls are fixed to a plate, on one end of a vertical vibrating lever, which works on a fixed centre at its lower extremity. This lever forms an armature to an electric magnet, and is attached thereto whenever the current is established, and drawn back again by a spring when the currrent is broken; thus as the current is being constantly established and broken at all the different clocks by any simple contrivance in the main or prime regulating clock, it follows that all the different armatures will be caused to vibrate simultaneously. This vibration gives motion to the ratchet wheel in each indicator, by means of the palls before mentioned, which are attached to the upper end of each lever; in this way the ratchet wheel is moved forward one tooth for every forward, and another tooth for every back movement of the armature. Two detents are also fitted to the plate carrying the palls, in order to take into the ratchet teeth after every movement, and hold the wheel steady until the next stroke of the armature."

[Printed, 2½*d.*]

1853, January 31.—No. 263.

BOREHAM, Samuel.—*Void by reason of notice to proceed not having been given within the time prescribed by the Act.* From the Provisional Specification it appears that the invention consists "in a new mode of constructing chronometers and watches so that they may beat distinct seconds or half seconds, and to strike at the minute or 60th second, so that seconds and minutes may be counted by the ear, while the eye is otherwise engaged, as in looking through a telescope or quadrant in taking astronomical observations."

As the balance comes forward, the unlocking pallet acts upon the point of the discharging spring, which point rests against a pin in the lever upon which it is fixed, which prevents any motion in the said spring while being acted upon in unlocking the escapement wheel. It therefore is the same only as a point in the lever, and consequently the lever is moved, and the detent with it, and the escape wheel is unlocked. The escape wheel being unlocked gives the impulse to the balance, but while doing so the said wheel acts upon an inclined plane, which is upon the lever at the opposite end to the locking pallet. The wheel by so acting on this plane conveys the locking detent in, ready to receive and lock the tooth now become due. In this action it is assisted by a small spring, which is fixed to the arbor of the lever, and to the plate of the movement. The minute stroke is gained by having a small hammer raised by a wheel with sixty teeth, which wheel is placed upon the centre wheel of the movement, and moves round once in an hour. The hammer is thus raised by each tooth of this wheel acting upon it within the space of a minute, and the hammer thus locked upon the end of a lever. The other end of the lever is acted upon by a small pallet which is placed on the fourth or seconds wheel; and when this pallet has arrived at a given point which indicates the sixtieth second it has moved this lever sufficiently to unlock the hammer, and the hammer is immediately impelled against a bell spring by the force of a small spring acting upon it.

[Printed, 2½*d.*]

1853, March 7.—No. 570.

WATSON, Joseph John William.—"Improvements in illuminating apparatus, and in the production of light." The improvements in the production of light consist in adapting the mixed gases, oxygen and hydrogen, as they are obtained from the decomposition of water by galvanic or other agency, to the purposes of illumination, by causing them to impinge during their ignition against certain non-combustible, or nearly non-combustible, radiating mediums. The only part of the invention that relates to clocks, is the application of apparatus moved by clockwork to impart a rotatory reciprocating and advancing motion to the radiating body, on which the flame impinges in lamps of any construction for the burning of hydrogen or oxyhydrogen gas, from whatever source obtained.

[Printed, 5½*d.*]

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., OCTOBER, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the Shade. Dry bulb.	Wet bulb.	Highest.	Lowest.	Wind. True Direction.	Force (0 to 12.)	Weather. At 9A.M.	During the next 24hours.
	Inches.	o	o	o	o				
1	30·151	52	49·5	59	46	NE	1	cb	cb, p
2	·222	55	53	60	47	E	3	cb	cbq
3	·364	50	47	58	45	ESE	6	c	cbq
4	·228	48	45	53	42·5	E	7	b	bcq
5	·116	47·5	45	51	40	E	6	b	bcq
6	·186	46·5	45	54	38	E	3	b	b
7	·281	49	48	56	42	E	2	b	b
8	·267	48	47	58	40	E	3	b	b,c,m
9	·216	52	49	56	48	NE	3	o	o
10	·268	48	46	56	46	N	4	bc	cb
11	·380	48·5	47	55	47	N	2	c	c
12	·314	51	48·5	56	47	NW	1	o	o, c
13	·141	52·5	49	57	47	NW	3	o	o, c
14	·087	52	51	56	46	W	1	o	o, c
15	·165	44	42	57	40	N	3	b	b,m,r
16	29·954	50	48	53	43	WSW	4	c	opq
17	·714	53	51	57	48	WSW	4	o	op
18	·700	53	51	59	48	WSW	3	c	c
19	·380	55	54	58	46	SSE	3	b	b,cpq
20	·273	51	49	65	47	W	7	b	bc
21	·555	49	48	56	43	S	2	om	m, rr
22	·183	52	51	56	48	SE	3	r	o, r
23	·074	53	52	57	48	WSW	3	o	o
24	·351	44	42	55	39	CALM	0	f	bc
25	·553	47	46·5	54	42	ENE	3	m	o, p
26	·379	54	52	56	47	ENE	3	o	o, rr
27	·263	54	53	56	50	NNW	2	o	om, p
28	·518	51·5	50·5	57	48	CALM	0	f	bc, o
29	·682	53·5	51·5	57	47	E	4	o	omr
30	30·050	48	47	54	46	ENE	3	o	o
31	·207	46	44	49	40	E	4	c	c
	29·878	50,3	48·5	53	44·6	—	3·2		

REMARKS.

The relative prevalence of the winds was N, 6; E, 13; S, 4; W, 6; to twice calm.

On the 20th at about 2 a.m. the barometeric column had fallen to 28·924 inches, wind SW, a gale.

Rain fell on 11 days to the amount of 1·06 inches.

The prevalent wind having been from the E there was a deficiency of rain, and the mean day temperature was about 5° below the average.

EQUATION OF TIME TABLE

FOR DECEMBER, 1864.

Day of the Week.	Day of Mth.	At Apparent Noon. Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At Mean Noon. Equation of Time to be *added* to Mean Time.
		m. s.	s.	m. s.
Thurs .	1	10 34·97	0·961	10 34·80
Fri	2	10 11·59	0·986	10 11·42
Sat	3	9 47·62	1·010	9 47·46
Sun ...	4	9 23·09	1·033	9 22·93
Mon ..	5	8 58·02	1·055	8 57·86
Tues...	6	8 32·44	1·076	8 32·29
Wed ..	7	8 6·39	1·095	8 6·24
Thurs .	8	7 39·86	1·113	7 39·72
Fri	9	7 12·92	1·131	7 12·78
Sat	10	6 45·56	1·148	6 45·43
Sun ...	11	6 17·80	1·163	6 17·68
Mon ..	12	5 49·70	1·177	5 49·59
Tues...	13	5 21·29	1·190	5 21·18
Wed ..	14	4 52·56	1·202	4 52·46
Thurs .	15	4 23·54	1·213	4 23·45
Fri	16	3 54·30	1·222	3 54·22
Sat	17	3 24·84	1·230	3 24·77
Sun ...	18	2 55·20	1·237	2 55·14
Mon ..	19	2 25·42	1·243	2 25·37
Tues...	20	1 55·52	1·247	1 55·48
Wed ..	21	1 25·54	1·250	1 25·51
Thurs .	22	0 55·51	1·252	0 55·49
Fri	23	0 25·45	1·252	0 25·44
Sat	24	0 4·58	1·250	0 4·58
Sun . .	25	0 34·55	1·247	0 34·54
Mon ..	26	1 4·44	1·243	1 4·42
Tues...	27	1 34·20	1·237	1 34·17
Wed ..	28	2 3·79	1·229	2 3·75
Thurs .	29	2 33·18	1·220	2 33·13
Fri	30	3 2·32	1·209	3 2·26
Sat	31	3 31·17	1·197	3 31·10

ADVERTISEMENTS.

	s.	d.
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Five per cent. discount on the above charges if three or more insertions are paid for in advance; and ten per cent. on six or more insertions.

N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 23rd of the month.

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BRITISH HOROLOGICAL INSTITUTE.

REPORT OF THE COUNCIL READ BEFORE THE HALF-YEARLY MEETING OF THE MEMBERS, DECEMBER 30th, 1864.

The expiration of another half-year imposes on the Council the duty of laying before the Members of the Institute an account of the events of interest, which have occurred within the Institute since the last report, the statement of the Financial Position and such promises for the future, as they may find themselves able to offer with a prospect of safe performance. The essential property of an Institute, for excellence and success, is doubtless, a secretary willing and competent for the work. After long and painstaking comparison of many candidates, the Council had selected one of whom they forbear saying more, than that he greatly disappointed the hopes they entertained respecting him, and that on the first discovery of his deficiencies they suspended him from further service, and shortly cancelled his agreement with the Institute by his discharge. The recommendations of some Members of the Council, supplied a gentleman for the temporary exigency, of whom, the Council are happy to report that his probationary service was so satisfactory, that they have elected him to the office of Resident Secretary. Under his management many out-standing accounts due to the Institute have been recovered, subscriptions from members have been collected with unexpected success, and as the result, the debt to the printer of the Journal, which was an inconvenient and somewhat discreditable burden, secured indeed by assets, though not immediately available has been greatly reduced. It is right however to say, that a considerable diminution of the debt, was made by a subscription among members of the Institute. This more exonerated position enabled the Council, on the commencement of another volume of the journal, to issue notices for tenders for printing the journal, to five of the leading printers, and they are happy to be able to report, that they have obtained lower terms than they have hitherto had, without impairing the quality, and thus favored the pecuniary resources of the Institute. The vitality of the Institute under the late discouragements, viz., the period before the appointment of a Resident Secretary, subsequent to the resignation of the last Honorary Secretary, and the failure of the first appointed resident Secretary, indicates a stronger constitution than some even of its most active members had expected. To live in fair weather requires no great vigor, but to baffle the storm exacts extraordinary energy, and the Institution happily found among its members, men adequate to the crisis. Relieved from the obligation, of providing for its efficient working, the Institute has had opportunity to fulfil purposes that it had already conceived; accordingly, after collecting copious information on the subject of Hall-marking, a public meeting was held, attended by many of the leading members of the Trade, at which resolutions were passed, condemnatory of the present mode of stamping, assaying, and charging at Goldsmiths' Hall, and a deputation appointed to seek an interview with the company to obtain reform. The members will recall several interesting lectures, that have been delivered by members of the Institute, and the Council are able to announce that a supply of lectures during the ensuing winter months has been provided, and men of eminence have promised their support. Encouraged by the consciousness of their own worth and beneficial services to the trade, the members of Council have felt emboldened to ask the fellowship of members of the trade, and membership of the Institute, and with a few exceptions, their requests have been complied with; valuable and influential members have thus joined the Institute. The recognition of the Institute in the public press, has given it a position that in its earlier history it had not. But what more par-

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ticularly the Council have reason to be pleased with, is the recognition which the Astronomer Royal has given the Institute, by nominating one of the gentlemen connected with the Observatory, to deliver a lecture before the Institute in the month of February, on the System of Time Signal practised at Greenwich, which had not hitherto been made known to the public, and the gentleman referred to, Mr. Ellis, kindly assented to the Astronomer Royal's suggestion. This favorable assistance to their purpose, the Council feel will give such impulse to their organization, that not to be a member of the Institute, will argue oneself a defaulter in the scientific ranks of the art.

The usual annual dinner, with its accompanying subscription, the Council trust will bring together a large assemblage of the members of the trade, with the view to scientific progress, and thus establish in society, for the art, an estimation which gatherings for the sole purpose of charity, laudable and obligatory though they be, could not effect, and the Council look for the fund then ordinarily collected, as a means of placing at rest for the future, the pecuniary status of the Institute.

PUBLIC MEETING HELD AT THE

BRITISH HOROLOGICAL INSTITUTE,

24TH NOVEMBER, 1864, RICHARD WEBSTER, ESQ., *in the Chair.*

The object of this meeting was to take into consideration the propriety of addressing the Goldsmiths' Hall as to the injurious treatment of the work sent to them for assaying and stamping, and their excessive charge for the same. There was a large attendance of watchmakers and jewellers.

The CHAIRMAN in opening the meeting, said he had much pleasure in taking the chair that evening. It appeared this meeting was the result of one or two preliminary meetings on the subject, and there could be very little doubt that a reform was required. He would therefore call on Mr. Jones, who would give them some facts about the manner in which the cases were damaged under the present system.

Mr. Jones said:—The Council have entrusted to me the duty of moving the first resolution, and in doing so, I think it satisfactory and encouraging to perseverance to know that we are aiming at a result in which not merely our trade, but the public generally are concerned, that we have a complaint for which to seek redress that creates surprise at the supineness that has so long allowed it to exist, rather than one that needs much argument to show its oppressiveness. The objection set forth in the resolution is to the method of scraping and assaying watch cases, as practised in Goldsmiths' Hall, and the charges for the same. With reference to the Goldsmiths' Company, I do not think that we shall have any serious difficulty to encounter in obtaining our request. I have heard the idea expressed that it would be far better for the Government to take their duties in hand. I do not agree with that, I believe we should find ourselves brought under a power far less accessible and amenable to reason, than the corporate body who are the objects of our remark this evening. It could be desired that the constitution of the company had more connection with our trade. They are not indeed familiar with the nature of metals and alloys, nor with the chemistry needful for their analysis, being for the most part engaged in dealing in corn, tea, sugar, pottery, and other articles of produce. Yet they are men of business, intelligent, and well meaning, to whom I feel sure it will only be necessary that we show our grievance to have their co-operation in carrying out our desires. It must be obvious to every one, that it is contrary to the rules of business for one workman in the successive steps of a manufacture to destroy or injure the

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work of the preceding workman in doing his own. Yet this is the injury practised at Goldsmiths' Hall, against which we meet to protest, and though the injured work is returned to the prior workman, to be set right, yet no skill can restore the original condition of the article. We might then, on the simple rules of business, expostulate with the Goldsmiths' Hall and require them to find out a way of doing their work, which should not damage work already done, but when their process is a serious impediment to us in our competition with the foreigners, who are free from such loss, it becomes a question of public policy, which cannot be allowed to slumber, even though an adverse decision should be made to our representations to the Goldsmiths' Company. The whole watch trade is concerned in this movement. The casemakers at first sight might seem most interested, but such is not the fact. Every finisher and escapement-maker is more concerned than the casemaker for the increased cost of making a case dependent on the Goldsmiths' Hall, is charged on the complete watch to the disadvantage of the English manufacturer, while so far as the superior mechanism of the English watch creates a market, the English casemaker enjoys the monopoly of the market.

This will in some measure explain the absence of the casemakers whom we might have thought would have attended in the largest numbers, but not wholly—an opinion prevails among them, with what just reason I am unable to say, but not the less is the opinion existing, that if they show themselves in antagonism to the Goldsmiths' Hall their work will be more severely treated, such as by putting their work in doubt. That the Goldsmiths' Hall has the power of putting their work in doubt on just reasons, I know, and that three days in succession it may be so treated, the Act of Parliament gives authority, and that in the event of the triple doubt the work may be broken, and that without appeal or redress, is a fact well known, and possibly it is the fear of provoking such a power, that makes the casemakers cautious how they make themselves conspicuous, but any one who has seen a case as it returns from the Hall will at once see that it is time a better method should be adopted. We had some cases before us at a late meeting on this subject, and the appearance of the case was that of an opera hat, bruised, put out of shape, scarped, wounded. To assay it is not necessary that more than six grains should be used, but off the two cases referred to fully 20 grains had been scraped. I know of a transaction in which £15,000 worth of gold changed hands where only one grain was able to be used by the assayer, and on such an assay such an amount of gold changed hands, but that is an exceptional matter only mentioned as a chymical curiosity, but six grains is a commercial quantity, and no careful assayer ought to take more. Such is the depth of scraping that cases are subjected to, that casemakers object to send a light case singly to the Hall, for the scraper would make a hole in the bottom, they therefore send two or three at a time, that the quantity for the assay may be taken off the three, and so each be less distressed. For the Mint they take triple assays where sums of a quarter of a million are concerned, but for such small amounts as the Goldsmiths' Hall guarantees such precaution is not needed, particularly as their work is rather verifying the result found, than finding an original result. That the assayers work is done at the Goldsmiths' Hall, with all the precision that science can suggest admits indeed of some doubt, the number of cupels they put in the fire at once, is more than some assayers of skill would consider it safe for any man to attend to; even at the least, there are always uncertainties in assaying, some gold evaporates with the lead from the cupel; in weighing for the equivalent of the Troy pound, the merest atom which a breath may blow, is enough to affect the calculation, and all men may make errors, and if so, the weigher of such particles may err, but for the purpose of the public it is near enough, in truth it seems somewhat contradictory to seek for mathematical precision in assaying the several parts of an article which is destroyed as soon as the solder unites them. If it be admitted that scraping must be done, then the work should be put in a

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lathe, and a shaving slightly turned off, without disfiguring the work, but I do not think it necessary for mathematical precision to be reached in the assay. Even with all their care at the Mint, the Bank of England, on buying old sovereigns, loses in the quality of the gold, for the managers, in regard of human fallibility, are allowed a margin of error, and generally avail themselves of it, to the prejudice of the coin; yet though abstract precision is thus evaded, it is sufficient for the purposes of the public. I submit then, that the method of the touchstone, as practised in the Paris Mint, is near enough for practical use. The judgment of the assayers, in Paris, is allowed to be within one per cent. of the value, and the stamping of all jewellery is in France a government service, for a duty is levied on all jewellery and gold wares in France; if then for the French government, the touchstone is accurate enough, it ought to be enough for our English public. I was reading the other day, the recommendations of the Director-general of the Paris Mint, for the guarantee department as it is called, is a branch of the Paris Mint. And after advising a frequent observation of the strength of their acid it recommends the assayers to keep the judgment of their eyes correct by occasionally using the cupel. The touchstone cannot injure the work, and refiners will give as much for Paris Gold that has only been subject to this Mint, as for our English Hall system of test. The prices also of our marked Gold, showing the accuracy of the assay office are more than is justifiable, if one assay will do for three or more cases then we ought only to have to pay for one assay. The expense is larger here than at the Paris Mint, and larger considerably than in Switzerland; every facility should be given to our running the race on the world's markets with our brethren abroad. I therefore move this resolution.

Mr. Klaftenberger seconded the resolution which was carried.

Mr. J. JACKSON in moving the second resolution "That the character of the Die used in stamping the Hall mark, is injurious to the work, and ought to be altered,"—said the damage done in stamping the Hall mark, had been stated by a casemaker to be equivalent to about 30 per cent. of the journeyman's wages on moderately light cases. The cases were stamped with a blow that must inevitably distort the case, even in the unfinished state, and spoil the fittings, in fact it could with difficulty be made a perfect case after this operation. That fact could not be resisted by the gentlemen of the Goldsmiths' Hall, and he had reason for saying they would not if the matter were properly brought before them, refuse to consider the necessity of a reform; as some years back, the representation of a body of casemakers, was followed by an alteration of the size of the die, to the present diminished size, the old dies being discarded. He did not dispute the value the Hall mark gave to British work commercially, and did not believe the interest derived from this source, said to be not more than £1500 per annum, would prevent the authorities from meeting them fairly on this matter, by adopting a die that would cut like an engraving, and which would be sufficient for all purposes. It was not possible for English watchmakers, to have a light case made for a watch, as did the Swiss,—for it would never stand the die now in use being brought down upon it, as is the present practice, and it would be literally spoiled. About 90,000 silver and 30,000 gold cases were annually stamped at Goldsmiths' Hall, representing at a low estimate a value in the "fashion" of £50,000. The injury done to these, has been stated at about a third of this cost. Let us put it that a fifth more labour is required to imperfectly restore the shape and fittings, and it would appear that the Goldsmiths' Hall inflict a penalty on our manufactures of £10,000 annually, to say nothing of the loss of capital required in increased weight of gold, and delay by the workman's operation being suspended, from the impossibility at present of sending a finished case to the Hall to be marked. In Switzerland and France, finished cases were stamped without injury, and was it reasonable to suppose that a wealthy Corporation, would continue to insist upon inflicting on the watchmakers of Clerkenwell and elsewhere, so serious, and so unnecessary as it appeared to him, an

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annual loss? He felt some surprise at seeing so few watch-casemakers present, and if their absence arose from the fear of exciting the displeasure of the gentlemen of the Goldsmiths' Company, that seemed to him scarcely creditable. The character of the present die as required to be used, is injurious to the work, and raises considerably the cost of the manufacture, and therefore it ought to be abolished for some less rude and harmless process.

Mr. GLASGOW seconded the resolution. He did not believe the Goldsmiths' Company would be ready to receive a suggestion from them. Corporate bodies generally were slow to adopt improvements, and he did not believe the Goldsmiths' Company was a bit better than others. The Goldsmiths' Company allowed the Swiss to import their cases duty free, and if it was not necessary for those to be stamped and destroyed, why should the English cases be so? The cat's face that was used by the Goldsmiths' Company, would go through 19 out of every 20 Swiss cases. If their cases must be stamped, they had a right to demand that a stamp be used that would not destroy their cases. He did not believe they would be listened to by that company, until they gave them to understand that if they did not make some alteration they would apply to other sources.

After some conversation the resolution was carried unanimously.

Mr. BENNETT, in moving the third resolution, "That a deputation be appointed to obtain an interview with the court of the Goldsmiths' Company to ask them to revise the present objectionable system of assaying, stamping, and charging, and report to a subsequent meeting, and that the following gentlemen be requested to form such deputation:—Mr. Valentine Knight (president of the institute), Mr Webster (chairman of the meeting), the trustees, vice-presidents, with power to add to their number"—said they were all agreed to-night that their grievance was a great one. Everybody grumbled, and well they might; but he did not understand why they did not put their own shoulders to the wheel to get rid of the grievance. It was cruel treatment of fine work. He thought this meeting could go to the Goldsmiths' Company, and that company would think it wise to make an alteration. It was a vital matter. It amounted to one-third addition to the cost, and why should their work be burdened with such a tax? It was but for them to raise their voice, and they might make their request equal to a demand. In these days they did not depend for justice on the Goldsmiths' Company, and if they stuck to it they would get what they wanted, or they would hammer at them until they did get it; and if they would not give it to them, they would go to Government; and if they would not give it to them, they would go to the public press. If the company saw they meant fight they would give way. If they were dealing with watchmakers they might say to them—Now, here are our grievances, and if you cannot deny the truth of them they are undeniable; but they could not say so to a lot of tinkers, tailors, and candlestick makers that the company was composed of. They should give the company to understand that they did not mean to stand it any longer, and stand it they would not; and if they told them that plainly they would get the system altered.

Mr. MYLNE seconded the resolution, which was carried; and after a vote of thanks to the chairman, the meeting adjourned.

DUBLIN INTERNATIONAL EXHIBITION OF ARTS AND MANUFACTURES, 1865.

An International Exhibition of Arts and Manufactures, will be opened at Dublin, on the 9th May, 1865, in Ornamental Pleasure Grounds, within the city. The Buildings comprise rooms, specially designed for Picture Galleries, as well as a spacious Hall, capable of containing several thousand persons. The under-

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taking is patronized by the Queen; and will receive the assistance of the Government. The Society of Arts represent it in London. Every means appear to be taken to render the Exhibition attractive and successful. It is to be hoped that it will receive cordial co-operation from those interested in the various departments of Arts and Industry. The productions of all nations will be admitted. No rent will be charged to exhibitors.

The general plan for the division of the Exhibition, will be Raw Material; Machinery, Textile Fabrics; Metallic, Vitreous, and Ceramic Manufactures; Miscellaneous Manufactures; Fine Arts.

The tenth class, will comprise "Philosophical Instruments, and processes depending upon their use; Photographic Apparatus; Musical, Horological and Surgical Instruments; Machinery employed in Spinning and Weaving, and in the manufacture of Wood and Metal; Machinery in general."

The twenty-third class, will comprise "Working in precious Metals, and in their imitation; Jewellery, and all articles of vertu and luxury not included in other classes."

Rough counters and wall space will be provided. All goods and articles for exhibition must be delivered at the building at the charge and risk of the exhibitor. The reception of goods and articles will commence on 1st March, and none will be received after 15th April.

Tickets will be issued to every Exhibitor, his agent, or servant, to enable him to pass into the building, until the 8th May, between certain hours, to arrange the articles for exhibition. Prices of articles may be affixed in all classes, with the exception of the Fine Arts. Exhibitors cannot remove their goods, or substitute others for them, during the period the Exhibition shall remain open, that is till October 1865, without permission of the Committee. Free admission, within certain limits, will be given to Exhibitors or their agents. Medals and Certificates of merit will be awarded. The Committee, considering that it will be interesting and instructive to the general public to have the opportunity of seeing the following and similar processes, will reserve sufficient space for showing illustrations of each of them. Steel-pen Making; Pin Making; Needle Making; Button Making; Medal Striking; Gold-chain Making; Engine-turning for Watches; Brick and Drain-Tile Making: Glove Making; Stocking Weaving; the Manufacture of Linens; the Manufacture of Woollen Fabrics; Ribbon Weaving; Glass Blowing on a small scale; Type Casting; Type Printing, by hand; Lithographic Printing; Copper-plate Printing: Earthenware Printing; Porecelain Printing; a Potter's Wheel; Turning in Metal, Wood, and Ivory; Lace Making of all kinds; Book-binding; Tabinet and Poplin Weaving; Straw-Plait Making; Pipe and Cigar Making. All intending Exhibitors must state whether they are the Designer, Inventor, Manufacturer, Importer, or Producer of the articles they propose to exhibit.

REPORT BY THE ASTRONOMER-ROYAL FOR SCOTLAND.

This report is dated Royal Observatory, Edinburgh, 4th November. The following are extracts from the document:—

The Sidereal Clocks. — The system of sidereal clocks—viz., three—controlled under Jones' system by a fourth, which is kept in a closet of more equal temperature than the observing room, continues to answer so well that it has been visited by the director of a new Observatory, and an estimate for a similar loud seconds-striking clock to ours has been procured from the makers of it, Messrs Ritchie & Son, of Leith Street. We are not, however, quite satisfied yet that all possible practical accuracy has been reached for the most refined purposes of astronomy, and only wait opportunity to carry out further some of the same principles which have already yielded us such improved results upon our experience of past times.

The Mean-Time Clocks. — The controlled mean-time clocks (excepting the unfortunate window-clock whose ruin by lightning we have not attempted, in the absence of funds, to repair), have likewise been performing admirably; and have been so much

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approved of, that two similar, but much larger ones have been ordered of Messrs Ritchie for the Imperial Observatory of Pulkova. They are both now finished and despatched to their destination, but were kept some time going under electric control of this Observatory in the same circuit with the Castle clock; and one of them, carrying a large and broad seconds' hand of one foot radius, and carrying it true to the Observatory indications, was both a triumph to Jones' system and an advance on public clocks for giving time accurately to the people. They are to be set up, it is believed, in St. Petersburg, to show the citizens there, by this useful electric control, the correct time at Pulkova.

Introduction of Mr. Sang's method of Adjustment.—The leading mean-time clock of our series has experienced a notable practical improvement in having had applied to it Mr. Sang's method of adjusting it to true time daily, or clearing off the small effects of its rate during twenty-four hours. This method was described by Mr. Sang in a paper read before the Royal Scottish Society of Arts last winter, and has been applied by him with his own hands to our clock, and with such excellent and truthful workmanship that the ordinary rate of the clock is really steadier than it used to be formerly, while the method of removing from its indications an absolute error of one, two, or three tenths of a second as may be required, is admirably simple, and incapable of being misused.

Edinburgh daily Time-Signals.—Our means, therefore, of working public time-signals are more nearly perfect than ever; and the Edinburgh daily signals have been given effectively by both time-ball and time-gun throughout the year; excepting that the former signal has failed on two occasions, and was totally suspended for several weeks during the summer while repairs were being performed. These were of a serious kind, for the wooden mast on which the ball traverses was found to be rotten, after its twelve years' service on the top of Nelson's Monument, and to require complete renewal—a difficult task on a very contracted and painful site, but performed successfully by Mr. Matheson and the Office of Works. The opportunity was taken too, at the same time, of improving the action of the air cylinder, by substituting for the old disc a piston of an elongated cylindrical figure; and with such remarkably good effect that the performance of the apparatus is vastly better now than it was when first erected; and while the velocity of the first part of the descent is unimpaired, the latter part is made so slow, and yet so regular, that it occupies more than twenty seconds; and it is difficult to perceive by eye, and quite by ear, when precisely the heavy mass comes to a rest.

The Edinburgh Time-Gun. — Respecting the time-gun, I had announced in former reports that it was everything we could wish it, except the occasional no-fire arising from a bad fuse. That one difficulty has now been practically removed, and since the 5th of last January there has not been a single miss-fire. The credit of this improvement is due altogether to the present master-gunner, W. Swanson Sprent, who, having made an original examination of the friction fusees, considered that the previous failures arose, not from any defect in the chemicals, but from the occasional imperfect fixation of the mechanical elements of the fuse. With this idea in his mind, he made up a small apparatus, and employed it in his own rooms for testing this portion of the manufacture of each tube before giving it out for the service of the gun, and the consequence is that not a single miss-fire has taken place since then. The improvement has been so decided, and the benefit so notable, alike to the credit of the chemists of the Royal Arsenal at Woolwich and the efficiency of the public service here, that I trust the Board will duly mention the case in their report to Her Majesty's Government.

The Distant Time-Guns.—The Royal Observatory, Greenwich, has undertaken the firing of the time-guns at Newcastle and Shields, in connection with the Electric and International Telegraph Company.

Close of the Glasgow and Greenock Time-Guns.—The first Glasgow time-gun was supplemented by a second one in St. Vincent Place, on 29th October, and these two by a third one at the Broomielaw, on the 10th November; while a fourth gun was added to the system at Greenock, on the 21st November, all four being then and thereafter simultaneously fired through the agency of the electric current from this observatory. Of each of the three Glasgow gun-fires, regular schedule returns on printed forms were sent here every week, and constitute now an interesting collection, illustrative of an experiment in its way unequalled anywhere, and now complete within itself; having come to a conclusion on the 6th February 1864, but not without reflecting the utmost credit on the several officers of the Telegraph Company employed to superintend the local management of the re-

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spective cannons. It would be easy to show from Glasgow newspapers that the time-guns greatly approved themselves there to citizens generally, notwithstanding some special cases of opposition. Nevertheless, these guns, once dropped by their original promoters, have remained silent since then; and, without Mr. Nath J. Holmes to assist, though many persons have tried, or are trying, no one has succeeded yet, so far as I am aware, in establishing a single time-gun in Great Britain other than the original one of Edinburgh Castle.

Time-Guns at Madras.—In Madras, it is reported that measures are being taken by the very able astronomer there, Mr. Norman Pogson, with funds supplied to him by the Governor in Council, to convert no less than five guns which are daily, at different hours, fired in and about that city, into time-guns, by connecting them electrically with the normal mean-time clock of his observatory; and he makes the remark, in his official document on the subject, that "the smoke by day, and flash by night of a time-gun, are far better and more conspicuous signals than any time-ball"—a remark that must be grateful to Edinburgh ears.

THE VOLUTOR.

Invented by H. JOHNSON, F.R.A.S. &c.

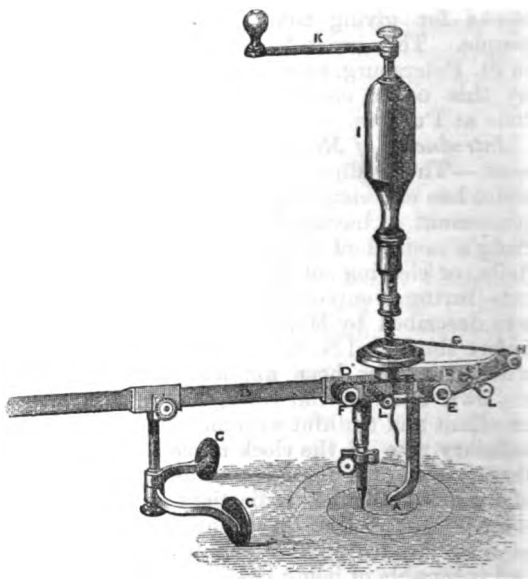
This instrument has been contrived for the purpose of facilitating, by means of mechanical arrangements, the drawing of VOLUTES, an operation that requires much time and care, and also the drawing of other spiral curves.

During the action of the instrument a band is wound round its axis, which regulates the pencil, and thus a continuous curve is traced, with a radius varying in length at every point.

The instrument has been adapted to tracing Volutes and other spirals commencing at the extremity of the radius vector, as shewn in the drawing. The radius of the curve is diminished at each revolution by the circumference of the axis.

For tracing Volutes a grooved cone is used as an axis, and the proportions of the cone and the grooves are adapted to the curves required.

The centre, A, is furnished with a sharp point, and round it revolves a horizontal bar or arm, B, which is supported on wheels, C C. The tracing pencil, pressed down by a vertical spiral spring, is fixed to the slide, D, which travels upon the bar, B. The pencil is protected from undue pressure upon paper, by the central point and by the wheels, supporting the Bar. A steel rod rises from the centre through a perforated grooved cone and



its handle, I, and is furnished with a small winch handle, K, with which the bar, B, is made to revolve, while the cone is held still by its handle, I. On the short end of the bar, B, is a small pulley, H,* over which a band, G, passes, one end of which is attached to the *base* of the cone, and the other is fastened to the slide, D.

When tracing the Logarithmic Volute, for which the grooved cone shown in the drawing is adapted, the pencil is placed at the distance of eight inches from the centre; one inch being the radius of the eye of the Volute, and seven inches the length of band required to wind three times round the cone, on which a line marks the commencement of each revolu-

* NOTE.—Volutes receding from the centre can be traced, if required, with the addition of a small pulley, screwed on to the outer end of the arm, B. One end of the band should be attached to the *apex* of the cone, and it should pass over this pulley in lieu of the pulley, H, as above.

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tion. The position of the cone is shown by a mark upon it corresponding with a mark upon the bar, B. The band is fastened to the slide by winding it on the screw, L, between the small pieces of ebony, and then tightening the screw. The cone is then held still by its handle I and the bar, B, is made to revolve three times with the winch handle, K. The cone is then released, and the bar which will now act simply as a bar-compass, is moved round once more, tracing a circle for the eye of the Volute.

In tracing the Volute of "Vitruvius restored by Goldman," for which the smaller cone is adapted, the pencil is placed at six and three-quarter inches distance from the centre, being three-fourths of an inch for the eye of the Volute, and six inches for the length of band required to wind three times round the cone.

When smaller Volutes with variations of of radius less than the circumference of the axis at each revolution are required, the effect of the band wound round the axis may be modified by passing it over some of the pulleys, one set of which, E, is attached to the centre, while the other set, F, is attached to the slide, D. The effect varies according to the number of lines of band over which it is distributed, as for instance when the band is passed over one pulley the effect is distributed over two lines, and the radius varies in a revolution one-half of the circumference of the axis; when the band is passed over two pulleys the effect is distributed over three lines, and the radius varies in a revolution one third of the circumference of the axis, &c. As, however, the modification of radius is confined to the curves traced while the band is wound round the axis, and does not extend to the radius of the eye of the Volute, it will be necessary to allow a length of radius for the eye of the Volute in proportion to the radius of the Volute proposed.

The instrument may also be regulated, when smaller Volutes are required, by turning the cone round, and thus winding the band three times round it, and placing the pencil at its proper distance from the centre for the radius of the eye; as, for instance, one-half of the inch allowed for the radius of the eye of the large Volute if the band is passed over one pulley, one-third of the radius of the eye if the band is passed over two pulleys, &c. On withdrawing the slide from the centre, allowing the cone to revolve, the pencil will be at the extremity of the radius vector of the Volute.

When tracing the *fillet* of a Volute, the cone should be turned round until the band is tightened, after the pencil has been placed at the proper distance from the first curve. The size of the axis is thus slightly altered, and a proportionate distance is maintained between the curves.

When a parallel curve is required, in lieu of a fillet, as the size of the centres must coincide, it will be necessary to alter the length of the band, to suit the position of the pencil.

A—Centre.
B—Horizontal bar or arm.
C C—Wheels, supporting bar B.
D—Slide, bearing tracing pencil.
E—Pulleys on centre.
F—Pulleys on slide.
G—Band.
H—Pulley on short end of bar B.
I—Perforated cone and handle, through which a steel rod rises.
K—Winch handle, on steel rod rising through perforated cone and handle, by which the horizontal bar B is moved.
L L—Screw fastenings for band.

The ancient geometers considered the mechanical description of curves as an important geometrical consideration. Euclid admitted no constructions whatever, except those that might be effected by the use of a right line and circle, that is by a straight ruler and a pair of compasses. Thus, when it is said that the trisection of an angle and the duplication of the cube are beyond the powers of geometry, nothing more is, in reality, asserted than the impossibility to contrive a construction—using only right lines and circles—which shall effect the mechanical solution of the problem. If we admit the mechanical construction of other curves, the problems in question are of the most elementary simplicity.

The most celebrated geometers in ancient and modern times did not disdain to exercise their ingenuity in the construction of instruments for the graphical description of certain curves by continuous

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motion. Thus the Greek geometer, Nicomedes, who lived two centuries before the birth of Christ, in the time of the philosopher Eratosthenes, invented the curve called the conchoid, which goes by his name, for the purpose of solving the problems just now referred to. He also invented a mechanical contrivance for its graphical description, called the trammel of Nicomedes.

The cissoid was a curve invented by Diocles, another Greek geometer, as a locus for finding two means proportional between two given right lines, on which depends the solution of the celebrated problem, the duplication of the cube. Newton did not think it unworthy of his genius to occupy himself in constructing an instrument for describing the cissoid mechanically. Sir John Leslie also invented an instrument for describing another geometrical curve, known as the tractrix. Instruments have been invented for describing other curves, but however ingenious they may be, they are but of little practical value. But an instrument which should enable architects to trace *with facility* the scrolls or volutes of columns, which are, in fact, geometrical curves, is a help of as much practical value as the elliptic compasses, or the protractor, or the pentagraph.

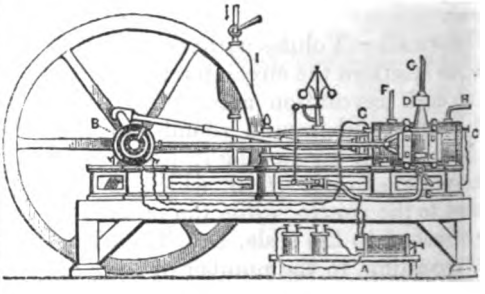
We believe that the instrument, wi l confer a real obligation on architects and designers of every class.

LENOIR'S GAS ENGINE.

To the Editor of the Horological Journal.

Sir,—The readers of the *Horological Journal*, will doubtless be interested in a new motive power, which in its recent application to drive machinery seems specially available for purposes connected with many branches of horological manufacture, where a moderate power is only occasionally required, and where common gas is readily obtainable.

The Lenoir engine, so called from the name of the inventor, M. Lenoir, in the employ of the Imperial Gas Company, of Paris, was shewn at the International Exhibition, of 1862, where a prize medal was awarded to it, but by strange oversight failed to find an appreciator, for it is stated that the Joint Stock Company about being inaugurated, have purchased the exclusive right of manufacturing it in this country, from the Paris Gas Company, at a cost one hundred times greater than it was offered for at the Great Exhibition, by the inventor. The chief recommendations of this beautiful application of a new motive power to the steam engine, (for the Lenoir engine is as at present made a simple high-pressure horizontal engine, just as would be used with steam), are that the objections to the introduction of a steam engine into our workshops and houses, cease to exist in this. The fear of explosion is at an end, for here it is by a series of explosions that power is communicated. The annoyance of heat, dirt, &c., inseparable from the generation of steam by the combustion of coal, is annihilated, while the expense of setting one up is (unlike the steam engine, where the machine is but a fraction of the whole cost,) an easily estimated, and small per centage of the cost of the engine; and the fixing it to its bearings, something like



the setting up of a powerful lathe; while the cost of working is a mere question of consumption of gas with the small additional expense of re-charging once a week the two small batteries which supply the coil with electricity for the spark discharging the gas at each end of the cylinder. This engine once started seems to require no attention all day. It can be easily and immediately stopped and set in motion with no more preparation than is required to see that the bearings are oiled, the batteries effective, and the gas turned on, while in ceasing to work expense is at an end. The cost of working being the cost of the gas consumed; with gas at 4*s.* 6*d.* per 1000 cubic feet, a one-horse engine works at an outlay of 4*d.* per hour. The cylinder does not appear to foul by the explosions, for these engines have been in use here for more than six months without cleaning, but it is recommended to clean the cylinder every three months. A half-horse power gas

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engine shewn in operation by the company at 40, Cranbourne Street, W. works as smoothly and with no more noise than a common lathe. Enclosed is a drawing of the Lenoir Engine, shewing the construction and mode of action.

A represents the electric battery.
B distributor of electricity.
C electric igniters.
D admission of air atmospheric.
E admission of gas.
F exhaust pipe.
G waterpipe inlet.
H waterpipe outlet.
I Indiarubber pouch.

A reservoir to prevent the gas as it is forced into the cylinder affecting light in use.

S. J.

MAGNESIUM.

This metal was discovered by Sir Humphrey Davy in 1807, but remained little else than a chemical curiosity until 1862, when Mr. Edward Sonstadt patented a series of processes, whereby it may be produced in any quantity. Magnesium is a metal white as silver, and very light; its specific gravity being 1·74 or about one-fifth the weight of copper. In the form of wire it may now be purchased at 3d. per foot at all the principal metallurgists, opticians and photographic material dealers. If the end of a piece of wire be held in the flame of gas or candle, it at once takes fire, and burns gently with a dazzling white light, by which a photograph may be taken with a perfection equal to sunshine. The wire supplies an excellent specimen of the metal, and the burning of a few inches is a brilliant and interesting experiment.

The great difficulty which has hitherto stood in the way of the utilisation of this very brilliant light has been the want of some means for its easy application. This difficulty is said to be now entirely surmounted. Mr. A. G. Grant, an American gentleman, resident at Nottingham, has patented an apparatus for the object in view. The wire is coiled on spools, and thence is drawn between cylinders to a tube through which it is said to be thrust at precisely the rate at which it burns. The apparatus will form a hand-lamp, or may be applied for other purposes,—such as the lighting of theatres, the making of fog signals, or signals of any kind. The hand-lamp will be especially useful to photographers. The increasing cheapness of the magnesium wire may soon cause it to be generally adopted where a very brilliant light is required.

A NEW THERMOGRAPH.

M. Marcy has addressed to the Academy of Sciences the following description of an instrument for marking small variations of temperature. It may, we believe, be rendered intelligible without a diagram. 1. The first part of this thermograph consists of a copper tube a metre in length, the interior diameter of which is capillary, not being more than one-fifth of a millimetre. It is open at one end, and soldered to a hollow copper ball at the other. 2. The second part of the apparatus consists of a wheel resting upon knife-edges, like those of a pair of scales, whereby a very delicate oscillation may be imparted to it. The axle of the wheel carries a long vertical needle, marking the degrees on a circular scale. To the circumference of the wheel is fixed a glass tube six millimetres in diameter, and bent in conformity to the curvature of the wheel, and so situated that the middle of the tube lies vertically underneath the needle when the wheel is at rest. One of its extremities is hermetically closed, while the other is open. Now, if a little mercury be poured into this tube it will settle at the lowest point, and the interior of the tube will thus be divided into two chambers, one closed and with air confined in it, the other open. 3. Now introduce the copper tube into the glass one, giving it of course the same curvature, and so that its extremity may pass through the mercury, thus establishing a communication between the hollow copper ball and the confined chamber, and the apparatus, with a few accessory appliances, will be complete. The end of the copper tube dipping into the mercury should be varnished to prevent its being attacked by the latter metal; or better still, the end might be made of platinum. 4. To use this apparatus, put your hand to the copper ball; the warmth thus imparted to it will dilate the air it contains, and drive part of it into the confined chamber; the mercury will therefore recede, and thereby make the wheel turn round its centre of gravity, the very small arc thus described will be revealed by the needle, the difference of its present position with its previous one when at rest. If, on the contrary, the copper ball be cooled, by water, for instance, the air inside will be contracted, a portion of the air of the confined chamber will rush in, and the mercury will be driven forward, the needle turning in the inverse direction. By means of this apparatus very delicate physiological experiments on animal heat may be conducted.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., NOVEMBER, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the Shade. Dry bulb.	Wet bulb.	Highest.	Lowest.	Wind. True Direction.	Force (0 to 12.)	Weather. At 9 A.M.	During the next 24 hours.
	Inches.	°	°	°	°				
1	30·252	44·5	43	49	48	E	4	c	c
2	·175	43·5	41·7	47	39	ENE	4	o	o
3	·278	41	40	47	37	NE	3	bc	bc, b
4	·486	36	35	50	32	CALM	0	f	m, bc
5	·336	41	40	50	33	CALM	0	f	bc, b
6	·580	39	38	50	35	NE	4	bc	bc
7	·546	37·5	35·5	46·5	33	NE	3	c	cb
8	·148	37	35	41	30	NW	2	m	om
9	·189	37 5	37	45	35	NNE	3	o	c, b
10	·128	33·5	32·5	47 5	28	NE	4	bc	c, b
11	29·978	34	33	42	28	N	2	o	f, m
12	·867	37	36	41	32	E	2	o	m,b,r
13	·435	45	44	45	35	E	2	om	r
14	28·784	46·5	45	50	44	SW	3	bc	bc, m
15	28·804	39·5	39	51·5	35·5	WSW	1	m	r, bm
16	29·294	43·5	42·5	49	38	WNW	2	o	o, r
17	·442	46	45·5	47	37	S	3	r	r, q
18	·225	51	48	53	44	SW	9	cb	cb
19	·884	48	47	53	37	S	2	o	o, p
20	·605	43	47	52	42	S	2	o	om
21	·874	42	42	52	39	CALM	0	ff	o, rr
22	·608	50	49	52	40	SW	3	o	o
23	·698	43	42	52	37	SSW	2	o	rr
24	·243	39	38	46 5	36	WSW	6	o	o, bc
25	·438	32·5	31	42	30	WSW	2	m	c, r
26	28·994	39	37·5	45	30·5	WSW	6	mc	o, r, b
27	29·694	38	37	44	33	W	3	mc	o, b, r
28	·760	53	52	53	36	SSW	4	m	om, b
29	30·344	38	37	54	35	WNW	3	o	o, b
30	·247	46	44	46	36	SSW	5	c	r, q
	29 811	41·7	40·5	48·1	5·8 3	—	3	—	

REMARKS.

The barometric column measured 30·71 inches at 4 p.m., 6th; 28·77 at noon, 14th; 28·93 at 4 a.m., 26th. The extreme range was very nearly 2 inches.

Rain fell on 12 days, to the amount of 2·38 inches. No rain fell the first eleven days. Frost was seen upon the ground on 9 mornings. Gales occurred on the 18th, 25th, and 30th.

According to the 9 a.m. observations, the wind was N on 5 days, E on 6, S, on 8, W on 8, and 3 days calm.

EQUATION OF TIME TABLE

FOR JANUARY, 1865.

Day of the Week.	Day of Mth.	At APPARENT NOON. Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *added* to Mean Time.
		m. s.	s.	m. s.
Sun ...	1	3 59·70	1·183	3 59·62
Mon ..	2	4 27·89	1·166	4 27·80
Tues...	3	4 55·67	1·148	4 55·57
Wed ..	4	5 23·02	1·130	5 22·92
Thurs .	5	5 49·93	1·111	5 49·82
Fri	6	6 16·37	1·091	6 16·26
Sat	7	6 42·32	1·070	6 42·20
Sun ...	8	7 7·73	1·048	7 7·61
Mon ..	9	7 32·60	1·025	7 32·47
Tues...	10	7 56·90	1·000	7 56·77
Wed ..	11	8 20·62	0·975	8 20·48
Thurs .	12	8 43·72	0·949	8 43·58
Fri	13	9 6·20	0·923	9 6·06
Sat	14	9 28·03	0·896	9 27·89
Sun ...	15	9 49·20	0·868	9 49·06
Mon ..	16	10 9·70	0·840	10 9·56
Tues...	17	10 29·51	0·811	10 29·37
Wed ..	18	10 48·62	0·782	10 48·48
Thurs .	19	11 7·02	0·752	11 6·88
Fri	20	11 24·69	0·721	11 24·55
Sat	21	11 41·62	0·690	11 41·49
Sun ...	22	11 57·80	0·658	11 57·67
Mon ..	23	12 13·22	3·626	12 13·09
Tues...	24	12 27·86	0·594	12 27·74
Wed ..	25	12 41·72	0·561	12 41·61
Thurs .	26	12 54·78	0·528	12 54·67
Fri	27	13 7·03	0·494	13 6·93
Sat	28	13 18·47	0·460	13 18·37
Sun ...	29	13 29·07	0·425	13 28·99
Mon ..	30	13 38·89	0·390	13 38·77
Tues...	31	13 47·76	0·355	13 47·71

ERRATUM.—In the Greenwich Rates, in our last number, Mr. Kullberg's chronometer, the first on the list, appears to have 8·7s, in the column headed, "Greatest difference between one Week and the next" this should have been 3·7s. It is not a misprint, but a bad type, as one can see by close inspection.

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BRITISH HOROLOGICAL INSTITUTE.

HALF-YEARLY MEETING OF MEMBERS.

The half-yearly meeting was held on the evening of December 30th, 1864, at the Institute, Northampton-square, Mr. Jones, V. P., occupied the chair. The minutes of proceedings at the previous meeting having been read and confirmed, the report of the Council on the last half-year, (which we published in our last number) was read. The Chairman then said:—

"It is usual to say a few words recommending you to accept and recognize as your own doing the transactions referred to in our report. Though we have had larger numbers in attendance on former occasions, I believe we never had a more satisfactory statement to lay before you. The debt owing to the printer has been greatly reduced; about £20 would put the Institute out of debt entirely, and more than that is owing for advertisements, with this exception we stand with a large amount of assets free from debt. The report speaks of difficulties we have overcome. I should not do justice did I not mention how much we owe to Mr. Jackson for his services given at much pecuniary loss to himself, during the inter-regnum of Secretaries. It is a source of confidence for all connected with the Institute that, when help is needed, the most prominent in the affairs of the Institute are the readiest to exert themselves till danger is over. I wish more of the Clerkenwell men and the trade generally better appreciated the work we are doing. We are giving our art a position in Society which the large range of knowledge requisite for success commands. Whether they help or not we benefit them. I wish that Mr. Johnson's generous enthusiasm on behalf of Earnshaw, in respect of his portrait had been better supported. The picture is an ornament to a room and all who can duly estimate the genius which furnished the most perfect of human instruments should have a copy. We look for accessions of members to enable us to do more for the trade. Our stock of measures is not exhausted, but fuller co-operation is essential. We have during the past six months escaped any expressions of ill feeling among members of the Council which in past times have been so inimical to the success of the work. Different views of the same subject are the necessary results of different minds; but those who have attended our meetings, which have been weekly, have recognized the rule of the majority as the law of the Council, and yielded their preferences to the wish of the larger number." The adoption of the report was then moved and carried.

The next business was the election of officers, and Messrs. Currier, Holliday, and Poole were appointed to fill the vacancies which had occurred on the Council; Messrs. Gunton, Bacon, and Evans were elected auditors.

Mr. Evans read a detailed statement of assets and liabilities, which he had prepared for the satisfaction of the members, and which showed a balance in favour of the Institute of about £300, and was the most satisfactory audit he had passed.

The Chairman moved that the thanks of the meeting be given to Mr. Strachan who gave his scientific experience to the service of the Journal, aided indeed by the Journal Committee of the Council, who cordially gave their assistance and advice. This having been seconded and carried:—

The Chairman moved a vote of thanks to the treasurer, Mr. Jackson, and remarked that, happily, he was a treasurer who, rent and taxes being paid, and all immediate liabilities removed, still had a balance. This was duly seconded and carried, and responded to by Mr. Jackson.

In conclusion, a vote of thanks was passed to the proprietor of the Clerkenwell News, the Chairman remarking that

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in giving reports of the work of the Institute in that widely extended sheet he created an influence for the Institute beyond its members. The thanks of an Institute comprising the pith and flower of Clerkenwell in every branch of our watch-making art could not be otherwise than acceptable to a gentleman whose office was as much to watch as guide public opinion. The members of the Institute might fairly be regarded as the men who in their generation were forming the destiny of the trade, not content with accepting an inheritance, they were the men whose energies were making a position for themselves, and on their science and abilities the real progress of the art at this time rested, so that a man's status might almost be known by asking was he a member of the Horological Institute. Of course the Editor of the local organ of Clerkenwell could not be indifferent to such an organization.

Mr. Evans replied to a vote of thanks accorded to the auditors, and the proceedings terminated.

GOLDSMITHS' HALL STAMPING AND CHARGES.

A deputation from the public meeting recently held at the Horological Institute, on the question of Hall-marking, attended at the Goldsmiths' Hall on January 9th, 1865, according to appointment, and had an interview with the Prime and three other Wardens of the Company. The deputation consisted of the following gentlemen:—Valentine Knight, Esq., *President of the Horological Institute*, Messrs. Webster, Jones, Jackson, Mylne, Glasgow, Bennett, Storer, Blackie, Holdsworth, Prickett, Lange, Evans, Loup, and Mr. Moore, the *Secretary* of the Institute.

The President commenced by remarking that his father, grandfather, and himself had been members of the company. He did not imagine he was known in that building; his having, however, been brought up to the trade, though he had now retired from it these twenty years, gave him an interest in its prosperity. He was deputed by a public meeting to lay before the Company certain resolutions embracing matters of complaint on the part of the watch trade. One of these was the injury done to the cases in scraping; another the amount charged for the stamping, which was stated to be more than the market price, and greatly more than the charges of the Paris mint; and another the injury resulting from the form of die used. These were matters on each of which members of the deputation would address them; and he would call on Mr. Jones to detail some of the points to which he wished the court to give their attention.

The Prime Warden called on Mr. Jones, who commenced by saying that a century ago the Goldsmiths' Company found themselves in a position of disadvantage with regard to their duties in reference to stamping, and obtained from the legislature better terms. After so long-standing a rate, the trade, in their turn, claimed a re-adjustment of charges in accordance with the altered condition of the manufacture. He presumed he was addressing members of the art, and would be glad to know whether he was correct in his conjecture.

The Chairman said that three of the four wardens were connected with the trade, but he did not allow the constitution of the company to be a question on this occasion. He would be glad to know whether Mr. Jones was a watch-case maker.

Mr. Jones said he was a watch manufacturer; his case-maker paid the demand of the Goldsmiths' Company, and charged him again, and as the maker of 1200 watches in the year, he had a right to see that he paid only what was correct, and was put to no greater cost than was necessary. It was important for him to know what were the capabilities of those whom he was addressing of understanding the technical terms of the art, else he might be unintelligible in much he had to say.

The Chairman said that he might use any technical words he pleased: they would be understood.

Mr. Jones said that the resolution of the public meeting appointed a deputation to meet the court of Goldsmiths' Company, and he was rather disappointed to find that the court had referred the matter to the officers, for as the court would have the responsibility of deciding on the question he thought it would have been well if they could have heard the statement of the case.

The warden, Mr. Gray, remarked that the Goldsmiths' Company had no pecuniary interest in the matter.

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Mr. Jones said he wished they had, for if there had been more members in the court they would, for their own interest, have long ago stirred in the subject, and effected improvement. The company was organised for the improvement of the manufacture in gold and silver, and the maintenance of the quality of the material. The former they had long given up; the latter only, was attended to. They were not there, however to complain of the dereliction of duty on the part of the Court, but to ask the Court to allow them to do their duty to themselves and the public. The large importation of foreign watches, to the displacement of English, showed that it was unwise to place unnecessary burdens on the English producer. The first matter he would speak of was the charge. By the act he had referred to, the company was allowed to charge 10*d.* for each gold watch box or case. When shagreen or tortoise-shell cases were made to cover the inside box or case, there might have been some propriety in charging for the inside box or case, and separately for the outside box or case; but when the change of fashion introduced cases with two bottoms it was an unfair straining of language to say that that made two cases. When the Legislature asked for a return of the number of cases the Hall had stamped, unless they proposed to bewilder the Legislature, they called each double-bottomed case a case.

The Chairman interposed, saying they always gave correct returns, and called a double-bottomed case a case.

Mr. Jones said, then why call a double-bottomed case to us two cases, and charge us as for two?

Mr. Warden Gray said, because with the extra bottom they had double trouble, besides 6*d.* on a gold watch was of no consequence. If the company charged it to him he could charge it to the public.

Mr. Jones was astonished to hear a gentleman connected with a corporation of 500 years standing, and assuming supervision over the art of Goldsmiths, delivering himself of thoughts which a child in the first catechism of political economy would not condescend to express. It was important whether the money on the many dozens he made went into his pocket, who knew what to do with it, or into the Goldsmiths' Company's pocket, who did not know what to do with it.

The Chairman wished Mr. Jones to confine his remarks to the question.

Mr. Jones begged then that he might not be interrupted. There was another matter in sending twelve cases; one assay for the twelve was practically sufficient; a small quantity scraped off each was the matter assayed; but, as Mr. Watherston, one of their honourable court, therefore, by their own admission, a respectable man, advertised that he would assay for 1*s.*, on what principle of fairness could the company demand 18*s.* for the same work? The honourable Warden had spoken of extra labour in the two bottoms, and of course would speak of extra labour in stamping twelve cases, but his workman had noticed how long it took him to stamp twelve bottoms, each with the five punches, which make up the number of his watches, and found that he could do them in five minutes. Now, as the Hall only used three punches, it could not take them so long as the five punches; so that at 1*s.* per hour for the man's time in stamping, the twelve bottoms ought not to cost more than about 1*s.* for stamping, which was hardly sufficient apology for the extra charge of 17*s.*, above the market price of an assay.

Mr. Warden Gray said that no account had been made of the cost of the dies, which were very expensive.

Mr. Jones was surprised that the Goldsmiths' Hall had no better a defence than so frivolous an element in the cost of stamping. There were other points raised by the honourable president, but there were gentlemen about to follow him who would handle those. Here he might stay, but that the trade desired to assist the Hall in the re-adjustment of its system, and had, therefore, considered the remedy as well as the complaint. The touch of Paris had from early times been the standard of purity, which, by their ancient charters, the company had been taught to observe, and the touchstone is still the test of the assayers of the Paris mint. They have the reputation of even more precision with the cupel than any; yet the touchstone is regarded by them as a sufficiently satisfactory test. It has long been known that the Chinese and Indians, by the trial needles, can determine the value of gold within 5*s.* per ounce by the mere hardness of the alloy; but with the additional test of the acid, it seems not unreasonable to suppose that the assayers of the French mint can guarantee the quality of gold to the satisfaction of the French Government, that makes stamping a department of revenue, and the protection of the fair trader.

The Chairman asked whether Mr. Jones knew of his personal knowledge that the touchstone was used in the Paris mint,

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Mr. Jones answered that of his own personal experience he did not, but M. Claudet, the assayer of Coleman-street, had told him that they did, and that the French assayers claimed the ability to indicate the value of gold within one per cent. by means of the touchstone. He further had the regulations issued by the Director-General of the Mint about twenty years ago, in which were the instructions regarding the use of the acid, and the charges for assaying by the touchstone.

The Chairman asked had he those regulations with him?

Mr. Jones said he had not brought them, since, being twenty years old, he thought it not well to rely on them as to charges, for they might have been changed since, and his friend Mr. Mylne had written to a gentleman in Paris, asking him to procure a copy of the present regulations, which he expected would have arrived by post in time for this meeting. He would, however, send it to the Chairman.

The Chairman asked Mr. Jones whether he knew that watch-cases were assayed by the touchstone at the Paris mint.

Mr. Jones said his only authority was that of Mr. Nicole, of the firm of Nicole and Capt, of Soho-square, watch manufacturers, who sent watches to the Paris Exhibition, and though they had the English Hall-mark on them, the French mint assayed the cases in the exhibition by the touchstone and acid, and stamped them without disfiguring the engine-turning, than which nothing was more sensitive to aberrations of form, for the reflection of light from the sides of the barleys showed the slightest injury. He did not suppose the laws of the Empire were suspended for the sake of the exhibition, nor that less care for the character of the French assay was exhibited when all was effort at perfection, in their respective departments. There was another grievance also that he wished to submit to the Hall, viz., the practice of marking Coventry cases with the London Hall-mark, by which watches of inferior quality were by means of the Hall introduced into the market as of London make, to the prejudice of the London trade.

Mr. Prideaux, clerk to the company, said that, by Act of Parliament they were bound to receive and stamp any cases sent to them in any state of completion by a case-maker whose name was registered at the Hall, without inquiry where the cases were made.

Mr. Jones said that that Act of Parliament was applied for by the company, and had worked in another way prejudicially to the trade, for foreign-made cases even now were sent to the Hall to be stamped with the English Hall-mark, and thus enable Swiss manufacturers to forge English names on the movements with better colour, and deceive buyers in the South American and other markets.

The Chairman said that was a point.

Mr. Jones hoped that mentally the Chairman had, during his remarks, to say the same frequently; else, if he had been speaking all this time without having made an impression till now, he was disappointed. In conclusion, he hoped that the company would comply with the wishes of the trade, for the reasons given, that there might be more concord between the Company and the trade, that at their annual dinners they might see the officers of the company, and that the company might reciprocate by inviting them to the dinners in their beautiful hall.

Mr. Jackson called the attention of the court to the injury done by the scraping and stamping.

The Chairman asked if he were a case-maker.

Mr. Jackson said that he was a watch manufacturer, but made cases on his premises; his father and grandfather had been case-makers. Mr. Jackson, in continuation, remarked that in a muscle-shaped case the injury done by stamping and scraping was irremediable.

The Chairman asked what was a muscle-shaped case?

Mr. Jackson handed one up, and said that when the cases were finished it was his practice to stamp his number on them, and by the use of his skeleton, or outline die, he was able to mark the figures on the bottom without disfiguring the cases, but the embossed or relief die of the hall could not be impressed without entire distortion of the case. He recommended a shaving to be taken off in the lathe instead of scraping.

Mr. Warden Gray remarked that it was indispensable, by act of Parliament, that the stamps be put on. The Queen's head was the indication of duty being paid. The stamps were works of art by the first artist in Europe, and their excellence formed the protection of the Government revenue. The company was frequently applied to when plate was passing inwards through the Custom House, to verify the stamp as entitling the plate to pay duty. If outline stamps were used, there could be no identification.

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Who ever heard of Government prosecutions in France? They could not verify their own dies.

Mr. Lange remarked that the Geneva stamp was very similar to the French stamp, and that there were frequent prosecutions in Geneva. He saw no difficulty in identifying an outline stamp. He remarked that on slight cases the relief stamp of the Hall was fatal. No case-maker would send a single case, if slight; he could not restore it.

Mr. Jones remarked that in one of the circulars of the director-general of the French mint it was stated that, whereas many forgeries of the mint stamp had been discovered, the punches were to be altered, which showed that they could distinguish forgeries. They had a rotary die, which, within the outline figure, yielded changing combinations of form, which made imitation very difficult.

Mr. Warden Gray would be glad to know more about that rotary die.

Mr. Glasgow said that if cases were stamped only when complete, dishonest case-makers, who might desire to put an undue quantity of solder, would be checked. The value of foreign cases was really greater than that of English cases, though they only passed the touchstone test, for no excess of solder was possible. The case-makers were the most non-progressive class of the whole trade, and they placed a restriction on the whole trade. He could get a gold dome hunter made in Switzerland, for 20s., whereas here he had to pay 50s. The Hall should, by using the touchstone, do less work, and charge less. He believed if they would withdraw the present impediments quite a revolution in the system of case-making would shortly arise. There was a large branch of trade in ladies' watches, which would then be practicable, which was now in the hands of the Swiss, for the English case-makers made them positively ugly, and threw the blame on the Hall.

Mr. Jackson said that there was a case-maker in the deputation, who would confirm his statement, that one-fifth of the value of making a case in this country, was occasioned by the interruptions and waste of gold, necessary in producing true forms after the Hall had done these injuries.

Mr. Blackie confirmed Mr. Jackson's statement that great loss accrued in restoring the surfaces injured.

Mr. Glasgow said, that the necessary steps taken by the case-maker and polisher to restore the case to a saleable state, obliterated the distinctness of the die, and rendered identification impossible, also that with the present stamps, no square work was possible.

The Chairman asked what was meant by square work?

Mr. Glasgow explained that where the stamps were, in the process of polishing the edges around the stamps were rubbed down, and a level surface was impossible.

Mr. Bennett said that he would take the commercial view of the matter. The restrictive idea of 6*d.* being no consequence in the price of an article, would not do in these days; when quantities were relied on for profits, small savings became essential to be observed. In these days, when the existence of the trade was at stake, they could not allow themselves to be dictated to by the Goldsmiths' Company. They must, if denied redress, go to the Board of Trade, and then to the press. The Goldsmiths' Company would find their own advantage by attending to the matter, for else in these days of free trade, it would be worth the while of any manufacturer whose trade was large, to send for his cases to Switzerland and with an 18 carat stamp, and the initials of the maker, there would be abundance of guarantee for the public. The Honorable Warden had spoken of the stamps being works of art. He surely must be joking. He had been nursing his little piccaninny so long, that he thought it the finest baby in the world. And then the clerk of the company thought it settled the whole case, when he told them the stamps must be put on by Act of Parliament. Why, if they could not get the offensive system altered, they would go with them, and apply to the Legislature to remove the injury. The Chairman had asked significantly if there were any case-makers present. It was not a case-maker's question, for they charged their extra labour to the manufacturers, and if it were, they were afraid to appear, lest their work should be always put in doubt in retaliation.

The Chairman said that was an entirely incorrect impression.

Mr. Jones said that several case-makers had offered money to assist the movement, but would not allow their names to appear.

Mr. Bennett said the jewellers also complained. Here was a chain, of which the links were filed and polished round; the form was beautiful; if he wanted it stamped, the chain maker objected, for he said, "Those fellows at the Hall will so spoil it, that I cannot restore it."

The Chairman said, that the officers of the company had listened with much attention

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to what had been said, and would give it their earnest consideration. The company had only one wish, and that was to carry out the Act of Parliament in the manner most conducive to the good of the trade and security of the public. They would take a business view of the question, and make inquiry how far the touchstone was available for precision. The character of the die was a question they would take into their thoughts, and how far a shaving in the lathe could be substituted for scraping. He could assure the deputation that in the reference of the case to the wardens of the company no disrespect was intended, the fact being, that the assay department was entirely in the hands of the wardens, the court having no control over it, not even to the regulation of its charges, or the management of its income and expenses. They would inquire into the French rates and methods, and at an early date report to Mr. Valentine Knight their decision.

Mr. KNIGHT thanked the Court for their courtesy, and their promised consideration of the case. The meeting at which the resolutions he had now the honour of handing in, and at which the deputation was appointed, held itself adjourned to receive the answer of the Court, and on receipt of the Court's communication he would lay it before the chairman of the public meeting.

The deputation then bowing to the Court withdrew.

[Mr. Valentine Knight has forwarded to the Council the letter received from the Goldsmiths' Hall, but it came too late for this number, it will appear in the next.—ED. H. J.]

Ancient Aztecs at Work.—The arts and trades of ancient Mexico produced not only what was necessary for the requirements of life but even articles of luxury. They were skilful weavers of cotton and aloe thread. With cotton they made a sort of cuirass *(escaupil)*, impenetrable by arrows. They were acquainted with a great many mineral and vegetable dyes, besides employing cochineal. They baked pottery for domestic uses, and made, like the modern Russians, numerous utensils of varnished wood. They had no iron, but supplied its place for tools with bronze, which by tempering acquires considerable hardness. Bronze, however, could not have been very common, because for the same purposes they employed a vitreous mineral harder than glass—obsidian, which they called iztli, found in volcanic formations. They cut this natural glass into plates with an edge, and employed it for knives, razors (although less bearded than we are, they still had barbers), arrow-heads, and spear-heads. From their mines, which they roughly worked, they extracted lead, tin, silver, gold, and copper. They excelled in working the precious metals. The ornaments and vessels of gold and silver which Cortes received from Montezuma before ascending to the table-land, as well as those which he found at Mexico, were cast, soldered, chased with the graver, enriched with gems, and enamelled with a skill at least equal to that of European goldsmiths. "No prince in the known world," Cortes wrote to Charles V., "possesses jewelry equivalent to his in value." And he clearly gives you to understand that the workmanship was in no way inferior to the materials. *Dickens "All the Year Round."*

On alloys containing Tungsten:—Mon. Caron has instituted a series of experiments, to determine the influence produced by tungsten upon the qualities of bronze, cast-iron, and steel. Tungsten was found incapable of forming true alloys with copper, tin, and gun-metal, the latter becoming less homogeneous and less tenacious than ordinary bronze, although harder. The addition of tungsten to cast-iron, was found to increase both the hardness and tenacity, in about the same ratio with the quantity of tungsten added. Even one per cent. of tungsten was found to exert a marked influence, the grain of the iron becoming regular, fine and greyish, and the fracture showing great homogeneity. The addition of tungsten to steel, was found always to increase both its hardness and its tenacity. The alloy exhibits a peculiar fracture with a brilliant lustre, so that tungsten-steel is easily recognised by a practised eye. Poor steel requires more tungsten, than steel of good quality. A good cement steel, alloyed with 5 per 100 of tungsten, gave a steel of excessive hardness, which, however, forged very well, though it required much more force than ordinary steel. After tempering it acquired a hardness, comparable only to that of the hard white cast-iron. A gun-barrel made of steel which on analysis proved to contain tungsten, withstood the explosion of a charge of powder 0·6m. in length, and weighing 150 grammes, with 5 balls of lead weighing 135 grammes. Steel of similar quality was obtained by fusing together, in an earthen crucible at a very high temperature, 2·00 grammes of highly carburetted steel, 800 grammes of good iron, and 20 grammes of tungsten.—*Ann. de Chimie lxviii*, 143.

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PAPERS ON THE SEXTANT. No. 1.

By R. Strachan.

Introductory.—Alluding to the Sextant, Sir John Herschel in his "*Discourse on Natural Philosophy*," says:—"That a man, by merely measuring the moon's apparent distance from a star with a little portable instrument held in his hand, and applied to his eye, even with so unstable a footing as the deck of a ship, shall say positively, within five miles, where he is, on a boundless ocean, cannot but appear to persons ignorant of physical astronomy an approach to the miraculous. Yet, the alternatives of life and death, wealth and ruin, are daily and hourly staked with perfect confidence on these marvellous computations, which might almost seem to have been devised on purpose to show how closely the extremes of speculative refinement, and practical utility, can be brought to approximate." The sextant which furnishes data for these marvellous computations, is next to the compass and the chronometer, the most valuable of nautical instruments; and like them, it is not free from imperfections.

From its portability and geometrical accuracy, the Sextant ranks as one of the most important of the numerous instruments designed for measuring angles; and is the most efficient instrument that can be employed by navigators, and travellers, for observing the angular measurements necessary for the determination of geographical positions. What the chronometer is to precision in finding the longitude, the sextant is to accuracy in ascertaining the latitude. In fact the sextant is a necessary companion to the chronometer; for the latter furnishes but one element of the longitude, namely, the mean time at Greenwich; the other equally indispensable element, the mean time at the place, cannot be determined at sea with sufficient accuracy without a sextant. When far upon the open sea, upon the unsteady footing of the deck, away from all the appliances now available for communicating and signalling correct time on land, the sextant readily informs the navigator of the precise altitudes of celestial bodies, whence the principles of astronomical science enable him to determine within a few seconds, the precise time of the day or night. Without the extreme refinement of mechanical ingenuity, manifested in the chronometer, the structure of the sextant, nevertheless, embraces scientific principles, and artistic abilities of no mean order, while all its movements and results are clearly traceable to geometrical demonstration.

A person may be a good observer with a sextant, and yet be comparatively ignorant of its capabilities. This arises from the abstruse nature of the subject, a certain amount of mathematical knowledge being required for its clear comprehension; while the want of ability in the majority of persons who profess to instruct seamen in nautical science, is the real excuse for the seaman's lack of even popular information, regarding the nature and causes of imperfection of his sextant and other instruments. The art of navigation is dependent upon the operations of the most sublime natural laws, and the sciences of mathematics, mechanics, astronomy, meteorology, magnetism and geography, must be studied by the navigator, to give him that knowledge which conduces to vigilance regarding those circumstances which may affect, so as to render erroneous those instruments with which practical art, guided by theoretical science, has furnished him, to enable him to shape and maintain his course, and measure his progress, on the unseen paths of the sea. Thus the log and sounding apparatus, the charts and sailing-directions, the barometer and thermometer, the sextant and chronometer, the compass beset with perils, are all liable to error; the nearest infallible instrument the seaman has is the Nautical Almanac.

These papers have been written with the purpose of conveying to seamen and others interested in the sextant, in as popular a form as possible, such information regarding this highly useful instrument, as all persons employing it should at least possess.

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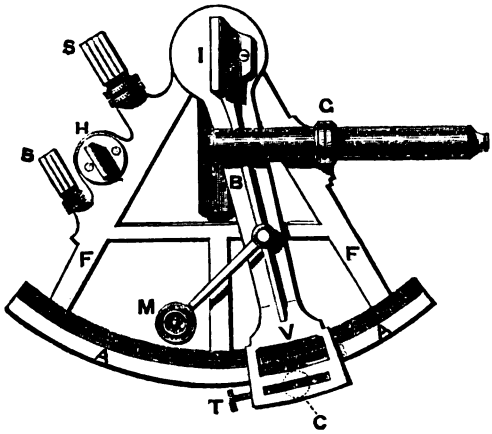

Fig. 1.

DESCRIPTION OF THE SEXTANT.—The various parts of a sextant, illustrated by figure 1, are designated as follows:—the frame, F F; the arc, or limb, A A; the index-bar, B; the vernier, V; the microscope, M; the clamp-screw, C; the tangent-screw, T; the index-mirror, I; the horizon-glass, H; shade glasses, S S; collar with slide and screw for the telescope, at G; the handle is attached to the back of the frame, where there are also three legs forming a triangular support to rest the instrument upon.

The instrument fits into a box which has receptacles also for the telescopes inverting and direct, plain sight-tube, coloured eye-piece, and screw key or driver, which always accompany it.

The frame and outer radii, braced together by lattice work, is composed entirely of brass, and is so constructed as to prevent as much as possible warping, or contortion from any cause.

The index-bar, or moveable radius, is a flat bar of brass with a longitudinal girder to give it rigidity. Near its lower end is an opening to receive the vernier, and exhibit the arc underneath. The extremity carries a spring, attached by a small screw, passing through a slit in the index-bar, to a block of brass below, which is made to lap upon the under edge of the arc there. The attaching screw is capable of being made to traverse the slit in the bar, and consequently to give this amount of movement to the spring and block. The clamping-screw works in this piece of brass, so that by screwing it up, the index-bar is kept in tight contact with the arc.

At the front end of the piece of brass is the tangent-screw, so called from its position relatively to the arc. It passes first through a part of the index-bar, formed for the purpose, so as to be capable of revolving without progressing, then its threaded portion enters the piece of brass. When the piece of brass is held firmly by the clamp-screw, the index-bar being then controlled by the spring, if the tangent-screw be worked, the index-bar being subjected to less resistance, will yield to the pressure of the screw, and thus receive a slow and small motion, while the clamp itself remains fixed. This is a beautiful contrivance, and is of much value; but it is difficult to understand properly without actual examination. The tangent-screw should never be forced to its extremity, either way of its play. It is known when its traverse is completed by greater force being required. Before it gets "hard up" as it is termed, it should be brought back to its central position; otherwise forcing the screw would probably distort or break its thread.

The *arc*, as part of the frame is brass, but the graduations upon it, are engraved upon an inlay of either silver, gold, or platinum; sometimes ivory is used, in cheap instruments.

The index-mirror is glass, silvered at the back, and set in a brass frame, fixed to the index-bar so as to revolve with it, and to be perpendicular to the plane of the arc, or "plane of the instrument" as it is termed. There are small screws at the back of this mirror, for the purpose of adjusting it.

The horizon-glass is smaller than the index-mirror, and is silvered only on that half of it next to the frame of the instrument. The other half is left transparent. It is set in a brass frame, the back being cut away from the transparent portion of the glass. The silvered edge should be sharp, and without flaw. Its frame is mounted on an axis and pivots in an exterior frame, and there are screws by which the glass may be set perpendicular to the plane of the instrument.

Four shade-glasses are usually placed before the index-mirror, two red, one

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green, one yellow; and three shade glasses before the horizon-glass, two red, and one green. They are circular, each is fixed in a brass frame, and each set is mounted upon an axis, so as to be perpendicular to the plane of the instrument, and capable of being turned either singly or together, before the respective glasses. The shades serve to subdue the light, and defend the eye from the brilliancy of the sun, or the glare of the moon.

The telescope is not an essential part of the instrument, but rather an auxiliary. It serves as a guide to the sight, and its magnifying power enables the contact of images of objects to be observed with greater exactness. The ring, or collar, for receiving the telescope, rests on two pivots against a companion ring, and is held to it by two screws. By loosening one screw, and tightening the other, the direction of the axis of the telescope is slightly changed. The companion ring is formed upon a brass stem, which slides through a socket in the frame, and by a screw at the back, may be moved backward and forward, so as to cause the line of sight to fall upon that part of the horizon-glass best suited for the observations.

The telescope screws into the collar. The eye-glasses are also threaded, for the purpose of screwing on in front a coloured glass when requisite; and they also slide into the tube of the telescope in the usual way, to enable the observer to adjust the focus to his eyesight. The microscope is held over the vernier by a flexible and moveable arm. It is for the purpose of magnifying the minute divisions of the arc.

A FEW WORDS ABOUT WHEELS.

The existance of an American Watch Manufactory, is now generally known, but that escapement wheels are beautifully cut upon the establishment, may not be so well known.

Whether this fact requires confirmation or not, should with those engaged in the occupation of wheel cutting, be a secondary question; they should rather accept it as true, and contemplate their own position as competitors with their enterprising cousins.

To cut a certain number of teeth upon a disc of brass is not the only requirement, and it is because the wheels produced in this country bear too much the impress of being fashioned under the prevalence of this crude idea that complaints are murmured by those who have the immediate handling of them. Considering the perfection attained in the various branches of watch-work by the assiduity of English workmen, it would seem somewhat anomalous, that complaints in the matter should be other than exceptional; the more especially as upon the escapement wheel the nervous vitality of the machine depends, if such a phrase be admissable. Perfection of material, a perfect tooth, and truth, are essential to an escapement wheel, yet in combination are seldom met with.

The material—brass—should be hard, very closed grained, free from flaws, and capable of bearing a high polish. In this particular uniformity should be attained, for a variation, if inferior, greatly taxes the patience of the escapement maker in the endeavour to produce a creditable appearance. Some few years since the brass used for the London made wheels, when polished, presented a rich gold tint, and such tint was readily given. If the brass be soft, however good the color it will bear, the brush will soon deaden it, as the brush injures soft gilding. A soft wheel, although the teeth be of the requisite thickness, cannot be considered sound, it being liable to distortion when brushed, and will receive injury under circumstances harmless to a hard wheel.

There can be but one opinion concerning the proper form of tooth for a lever wheel. Considering the angle from 64° to 66° as given by Mr. Scotchsford to be correct, the top of the tooth should pre-

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sent a well defined line, or thickness, and the back slope, a dead level, diverging from the parallelism of the face, only enough to ensure strength, and thus will be provided all possible room. For the pallets will give ample room for the dip of the angle pallet.*

Truth is most essential, not only with reference to the circumference, but also to the hole, which should be opened at perfect right angles to the plane of the disc. Truth should be found in the spaces between, and thickness of the teeth, this is called equality. If the spaces be equal, then the roots of the teeth will be equal also; yet it is possible to vary the thickness of the tops of the teeth, thus, "top" an equally cut wheel, the hole of which deviates from the centre by the process, it becomes unequal, both in thickness at the tooth point, and the spaces at the circumference. An engine would be in a sad condition to produce such a result. Such a wheel is unfit for use. Another requirement for equality is smoothness. Wheels have been cut, ribbed all down the face of the tooth, thus disturbing the mathematical precision that might have existed; for the extreme ends of some of the teeth will present the rib, and others the channel. A wheel to look well should have an uniform smooth surface, both on the teeth and band, quite free from cutter marks.

Some of the foregoing remarks are applicable to every kind of escapement wheel, but soundness of brass, that is freedom from flaws, is of far greater importance as regards the chronometer, and duplex, than the lever wheel. To prevent altogether the encroachments of this insidious enemy to the escapement maker, is perhaps scarcely possible. In the purity of the metals used for the alloy doubtless will be found the best remedy. Could the escapement maker with reason believe in his future exemption from the consequences of the evil, it would be a solace to his mind. It is scarcely to be borne when nearly having finished a chronometer or duplex wheel, to find a tooth split, or the surface blister and peal, revealing a blotch too deep for removal.

The "crossing" of the lever wheel should be considered the wheel cutter's business, not indeed to give the required finish, but so to open the blank that risk by filing be not encountered. An experienced hand will surmount the difficulty with tolerable ease, but to one not so practised the difficulty is greater than probably imagined; if such an one succeed in producing a presentable cross without damaging the teeth, the amount of time consumed in the achievement will detract largely from the accustomed profit. The Lancashire wheels are opened, and to such an extent as to spoil many, the arms being nearly severed from the rim, besides this, the best of them are unsightly, the arms being placed at some indefinite point between the teeth. A lever wheel to look handsome when crossed should have the arm immediately under the root of the tooth thus presenting the appearance of the tooth and arm being one length.

These few observations are offered in the hope of arousing our wheel cutters to increased endeavour to produce a wheel, that for purity of material, correctness of form, and exquisite finish, shall be irreproachable. With the exception of the character of the material, the whole matter is in their own hands.

Possibly the comparatively small quantity of brass used for wheels, being commercially of little value, may be assigned as one reason why no especial study has been given to the production of a superior alloy. For microscopic purposes glass is required, less in thickness than one hundredth of an inch. There is but one firm undertakes to supply the requirement, and it is probable the quantity used is but an atom in proportion to the general business. Surely some skilful metallurgist might be found, who would for the love of science take this matter into his serious consideration, and produce the desired material; "a consummation devoutly to be wished," improving not only the escapement wheel, but watch movements, which in this particular are not faultless.

E. Storer.

* Wheels may be sometimes met with having the back of each tooth curved forwards, as though strained by the cutter, such form is highly objectionable.

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The Characteristics of Thallium:—Thallium occurs in minute quantities, in many native metallic sulphides, especially in iron and copper-pyrites. Hence it is often found in commercial sulphur, in oil of vitriol, and in the sediment of sulphuric acid chambers, in metallic copper, bismuth, and cadmium; and in preparations derived from these substances. It likewise occurs in the flue-dust of furnaces and in certain mineral springs.

Thallium is a bluish-white, very soft and malleable, though not tenacious metal. Its specific gravity is 11·8. It is brilliant on a fresh-cut surface, but shortly tarnishes. It is easily fusible and volatilizes at a red heat. Before the blow-pipe it emits copious fumes of oxide, which have a peculiar odour, and exhibit a play of white, reddish and violet colors. In its chemical relations, thallium, in some respects, most resembles lead and silver; in others it is allied to the alkali-metals. It slowly dissolves in distilled water, (far less readily in water containing earthy salts,) especially when in a state of fine division. It dissolves readily in sulphuric and nitric acids and aqua-regia, slowly in chlorhydric, and very slowly in acetic acid.—*The American Journal of Science and Art, No.* 109.

A Letter written on a sheet of Iron, addressed to the Birmingham Journal, *from* "South Pittsburg (Pennsylvania) November 6, 1864," says,—"In the number of your paper dated October 1, 1864, there is an article setting forth that John Brown and Co., of the Atlas Works, Sheffield, had succeeded in rolling a plate of iron 13¼ inches thick. I believe that to be the thickest plate ever rolled. I send you this specimen of iron made at the Sligo Ironworks, Pittsburg, Pennsylvania, as the thinnest iron ever rolled in the world up to this time, which iron I challenge all England to surpass for strength and tenuity. This, I believe, will be the first iron letter that ever crossed the Atlantic Ocean.—Yours, &c., JOHN C. EVANS." The iron is said to be of exceedingly fine quality, and the sheet is by far the thinnest ever seen in this country. Tested by one of Holtzappfel's gauges, the thickness of the sheet is found to be the 1,000th part of an inch. A sheet of Belgian iron, supposed hitherto to be the thinnest yet rolled, is the 666th part of an inch thick, and the thickness of an ordinary sheet of note paper is about the 400th part of an inch.

Lenoir's Gas Engine.—There is a cylinder, as in the steam-engine, and into this gas is admitted by slide-valves, and there is also an opening which admits of the entrance of common air. In addition to these, however, there are wires which enter the cylinder, and which are connected with an electric battery. These are the only points in which the engine differs externally from an ordinary horizontal steam-engine. The parts are set in motion by the united action of the three agents—gas, air, and electricity. When the gas is admitted into the chamber or cylinder it is instantly ignited by the electric spark. The heat caused by the ignition causes the air to expand and force forward the piston; a similar expansion taking place in front, at the end of its stroke, drives back the piston, and thus a succession of backward and forward movements is secured. The gas and air may be used in varying proportions, but that which is considered most economical and most useful is about one of gas to twelve of air. If a larger quantity of gas is introduced there is a greater expansion of air, and consequently greater force available for driving the engine, and a diminution in the supply of gas causes a proportionate decrease in the power obtained. All that is necessary to set the engine in motion is simply to turn a tap just as would be done in the case of lighting an ordinary gas burner, and immediately the parts of the machine begin to move, and will continue to do so while the cylinder is supplied with the gas and air, and the conducting wires are kept charged. The machine works in a very quiet and easy manner, causes no vibration, and might for the little inconvenience which it causes be set to work in a drawing-room. For many purposes where motive power is required the Lenoir Engine might most advantageously supersede the steam-engine, and it would be found useful in many cases for taking the place of manual labour, such, for instance, as turning lathes, working sewing-machines, for which great steam-power is not required. *From "The Observer," 13th November*, 1864.

NOTICE TO MEMBERS.

The Council have sanctioned the publication in the Journal of a complete List of Members, stating their occupation and address. Members are invited to forward to the Secretary correct particulars, so as to ensure the accuracy of this compilation, which we presume will become a valuable Directory for the Trade.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., December, 1864.

11, *Offord Road, N.*

Days of the Month.	Barometer, at 32° F, and mean sea level.	Temperature in the Shade.				Wind.		Weather.	
		Dry bulb.	Wet bulb.	Highest.	Lowest.	True Direction.	Force (0 to 12.)	At 9 A.M.	During the next 24hours.
	Inches.	°	°	°	°				
1	30·155	45	44	48	36	SW	2	m	m
2	·397	34	33	45	32	WSW	1	m	m
3	·380	47	46	47	33	SW	1	o	o
4	·332	47	45	50·5	44	SW	5	o	om
5	·149	47	45	49	44	WSW	6	c	c, b
6	·018	49·5	49	52	44	SW	1	f	m
7	29·958	47	46	51	40	SSW	2	o	m,b,r
8	·647	46·5	45	50	44	S	3	r	r, m
9	·828	35	33	48	32	CALM	0	ff	f, c
10	·896	40	38	45	32	ESE	2	cb	m, b
11	·782	44	43	44	34	SW	2	m	m, b
12	·562	46	45	50	41	SSE	2	o	m, b
13	·585	40	39	49	35	SE	1	m	m, b
14	·773	40	39	49	37	E	1	m	mo
15	·808	35	34	42	34	ENE	3	o	o, m
16	·771	35	34	38	33	E	4	o	o, s
17	·833	31	29	35	26	E	3	o	smo
18	·863	27	26·3	32	18	E	3	om	ss, m
19	·935	29·5	28·7	35	26	CALM	0	ff	m, r
20	·836	40	39	40	27	ESE	1	om	o
21	30 046	40·5	40	44	39	WSW	2	r	o
22	·194	36	35	41	35	NE	5	o	o
23	·447	32	30	36	30	ENE	6	c	co
24	·598	31·5	30	34	26	E	3	c	o
25	·500	33·5	32·5	34	30	E	3	o	o
26	·352	35	32·5	35	32	E	3	o	o
27	·330	29	28	35	27	N	1	cb	c, m
28	·352	33	32·3	36	27·5	NW	1	o	o
29	·400	42	41	42	33	W	1	m	om
30	·044	42	40·5	44	40	SW	1	f	m
31	29·899	33·5	32·5	42	31	NNE	4	c	o, s
	29·993	38·5	37·2	42·7	33·6	—	2·3	—	Means.

Remarks.

The barometric column measured 30·65 inches at 10 a.m., 24th, and 29·54 at 2 p.m. 12th. Rain, or snow, fell on 8 days, to the amount of 0·51 inch. The wind, at 9 a.m., came from N, 3 times; E, 12; S, 7; W, 7; and there was calm twice.

During the year 1864, rain fell on 139 days, and the gauge collected only 17·47 inches, which is less than the average by the large amount of nearly 7 inches. For every Calm, the wind blew from the N, 4·8 times; E, 6·6; S, 4; and from W, 7 7 times, and the average force of all the winds was 2·8, according to observations taken at 9a.m. With the great deficiency of rain it will be remarked that the S and W winds were much below their average frequency.

Taking the observations of the winds, at 9 a.m., and assuming that they all blew with equal force, I have carefully calculated that the resultant of the winds of 1861 was equivalent to a wind of the same force blowing from N 81° 52′ W for 82·7 days; in 1862, N 83° 33′ W, 90·7 days; in 1863, S 81° 58′ W, 129·4 days; in 1864, N 67° 53′ W, 30 days.

The yearly mean of the four years is N 87° W, on 87 days.

Taking the same observations, and summing the estimated forces,—thereby assuming an equality between the units of the arbitrary scale (0 to 12) which though not absolutely correct, is perhaps on the average as reliable as each single estimation of the force by personal impression,—the resultants are:—in 1861, S 86° W, mean force 0·8; in 1862, S 85° W, mean force 1; in 1863, S 76° W, mean force 1·4; in 1864, S 88° W, mean force 0·5. The yearly mean of the four years is S 84° W, force 1 nearly. I regard these results as more accurate than the former. The individual observations are all recorded in the Horological Journal, so that the calculations may be tested by any one disposed to do so.

R. Strachan.

EQUATION OF TIME TABLE

For February, 1865.

Day of the Week.	Day of Mth.	At Apparent Noon. Equation of Time to be *added* to Apparent Time.	Difference for One Hour.	At Mean Noon. Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Wed ..	1	13 55·88	0·320	13 55·81
Thurs .	2	14 3·13	0·284	14 3·06
Fri	3	14 9·54	0·249	14 9·48
Sat	4	14 15·11	0·214	14 15·06
Sun ...	5	14 19·85	0·180	14 19·81
Mon ..	6	14 23·77	0·146	14 23·74
Tues...	7	14 26·87	0·112	14 26·84
Wed ..	8	14 29·15	0·078	14 29·13
Thurs .	9	14 30·63	0·045	14 30·62
Fri	10	14 31·32	0·012	14 31·32
Sat	11	14 31·24	0·020	14 31·24
Sun ...	12	14 30·39	0·052	14 30·40
Mon ..	13	14 28·78	0·083	14 28·80
Tues...	14	14 26·43	0·113	14 26·46
Wed ..	15	14 23·37	0·143	14 23·40
Thurs .	16	14 19·59	0·172	14 19·63
Fri	17	14 15·11	0·201	14 15·16
Sat	18	14 9·96	0·229	14 10·01
Sun ...	19	14 4·14	0·256	14 4·20
Mon ..	20	13 57·67	0·283	13 57·74
Tues...	21	13 50·57	0·309	13 50·65
Wed ..	22	13 42·85	0·335	13 42·93
Thurs .	23	13 34·52	0·360	13 34·60
Fri	24	13 25·59	0·385	13 25·68
Sat	25	13 16·07	0·409	13 16·16
Sun ...	26	13 5·98	0·432	13 6·07
Mon ..	27	12 55·32	0·455	12 55·42
Tues...	28	12 44·11	0·478	12 44·21

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ABSTRACT OF A PAPER ON WATCH OIL.

(Read before *The Edinburgh Horological Society*, January 11th, 1864),

By Mr. David Meek.

It is quite superfluous to say that it is of the greatest importance that the oil used in a watch should be good. There is none of us but has been taught this from the disadvantages attending the use of bad oil. These disadvantages are so many, and so great, that after once the watchmaker has experienced them they leave an impression on his mind which is quite indelible. What then characterises good watch oil? Good oil does not dry up readily. Although this is not so serious a matter to the watchmaker as the oil getting gummy, it is nevertheless more serious for the watch; in the former case the watchmaker feels the disadvantage, in the latter the watch is the chief sufferer. Another property of good oil is that it remains in the countersinks. Some oils seem to be of such a searching nature that they are found to spread considerably after being applied to the watch. This generally happens with very thin oils; and, although it is not a very serious evil seeing it does not entirely leave the pivot, still there are disadvantages connected with it which render the oil that remains in the *sink* to be preferred. Some consider that oil to be good must always retain the same color after being applied to the watch; probably more judge by this than any other thing. If it is found to turn green after ten or twelve months, it is considered as bad. Now in some cases it may be a sign of badness, but in others it is quite fallacious; for, although it will be found that the thick gummy oil is always green, it will also be found that oil which becomes green does not always get into a thick state, but may keep quite liquid. In all my experiments with oils, I have never yet got one which will remain on a piece of brass for a year without becoming green, and knowing that the color of the oil cannot have the least effect on the going of a watch, I have given up considering the changing of color, as a sign of badness. Oil to be good should not freeze too readily. If an oil gets thick before the thermometer reaches freezing point I consider it congeals too easily, but if at that degree of cold it retains its fluidity it is all that is needed; for, although during winter the cold is often below freezing point, a watch movement being not only kept within a case, but having also various other shelters, will seldom or ever be surrounded with air so cold as 32 degrees.

The requisite conditions of good oil are then—1st. That it does not get into a gummy state when applied to the watch: 2d. That it does not dry up: 3rd. That it does not spread over the plate: 4th. That it does not freeze too readily. The next question is what are the best tests for ascertaining good oil? Some will say apply it to a watch and try it. This no doubt is a very good plan, but it involves a considerable amount of attention; it cannot be decided in a week or a month, unless it be notoriously bad. It is too serious a matter to term this a wise plan for ascertaining the quality of an oil. There seems to be considerable difference of opinion amongst watchmakers, as to the best test for oils. Some test it by its color; if it is clear it gains their confidence. Others again prefer it with color. Some like it thick, others very thin. Some taste it; others smell it; while some try it by taste, smell, and color. Others again who find that their oil does not freeze in snow consider it perfect. Such are the various tests which are employed by watchmakers to ascertain whether oil is good or bad.

Having experimented for many years with watch oils, I consider the best and safest plan to test the quality, is to take several pieces of brass; make small countersinks in each piece, put a little oil into each sink; then place the pieces of brass away where they will be free from

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dust; and if at the end of twelve months the oil remains fluid it may be used with all safety. This may seem a very tiresome way of testing oil, but I know of no other sufficient to attain the object; a shorter time will not suffice. I have found some oils keep very well for eight or nine months, and after that period they rapidly became thick and bad. It will be found that oil keeps better on a gilt watch-plate, than on a piece of ungilt brass; the difference however, is not so great after all, and it is erring on the safe side to use ungilt brass when testing oil.

The next thing to consider is, where may we obtain good oil? This is a very important question, and one easier asked than answered. The animal, vegetable, and mineral kingdoms have all in their turn been explored by the various oil manufacturers, and while some give the preference to vegetable oils, others again prefer those which are obtained from the animal kingdom. Amongst watchmakers I have found the following oils most generally used: 1st. Olive oil: 2d. Nut oil, from barcelona, almond, and hazel nuts: 3rd. Neat's foot oil: 4th. Fish oil. In endeavouring to obtain a good watch oil, I have tried all these. I first turned my attention to olive oil, but after a year or two's experimenting, I gave it up, not because I consider it impossible to get a good oil from it, but from the difficulty of obtaining the oil in this country. A French watch oil manufacturer, in a book lately published states, that after experimenting for many years upon various kinds of oils he has come to the conclusion that the olive is the best from which to obtain a good oil for watches. He states that it is only a certain kind of olive from which the good oil is obtained, that the berry must be plucked at a certain stage of ripeness, and then only the virgin oil extracted from it. I have little doubt but that this French manufacturer will obtain good oil from olives on complying with the foregoing conditions; but to us, who must first take the oil in its adulterated state, it is a difficult matter to manufacture good watch oil from it. Having been advised by several watchmakers to try nut oil, I next turned my attention to it. Amongst the various kinds tried were walnuts, brazil, hazel, and almond nuts. The best oil was obtained from the hazel nut, and the worst from the walnut. I found hazel oil to keep liquid on a piece of brass for ten months, and on a gilt plate rather longer. It is certainly the best of all nut oils, but still is not up to the mark, as I shall afterwards explain. Having failed in obtaining a good vegetable oil my attention was next directed to animal oil. I first tried neat's foot oil. Having put it through the various processes necessary for purifying it, I put a little of it on brass; after lying past for a year I found it in far better condition than any vegetable oil I had tried. My next experiment was with fish oils; of these I have found none to equal sperm oil. I have kept it lying for three years on a piece of brass and it is as fluid as when first placed there. It has however the fault of spreading; as this oil seemed to possess the chief property of a good watch oil in a much greater degree than any other, I endeavoured to prevent its spreading when applied to a watch by mixing it with a small portion of bees-wax.

The proposed remedy however was worse than the disease, I then mixed with it a little of the neat's foot oil, which I found to answer the purpose very well, and for some years I have used this oil upon watches, and find it the best oil I have ever employed. Its color and smell will not recommend it to those who judge by these tests, but as I before stated, neither of these objections will affect the watch, and possibly both could be removed by some process, with which I am unacquainted, without destroying its good properties. I therefore give the preference to animal oil, for from it I obtain a really excellent watch oil. I have not arrived at that conclusion from any pre-conceived notions of its superiority, but from results arising from my various experiments. My great objection to nut oils and more especially to hazel oil, is their tendency to cause rust. Nut oils have a good look, a nice smell, and a fine taste; bury them in snow, and they will come out as liquid as when put in; use them on watches,

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and at the end of twelve months they are either getting thick or very red in color, thus indicating an early stopping of the watch.

The methods of preparing watch oil are numerous and diversified, what the best mode is I am not prepared to say. For filtration, I pass the oil through either blotting paper or charcoal. To remove the acid some use lead filings, others carbonate of soda, mixed with distilled water. The fatty matter is generally taken out by freezing and again filtering to purify it; some boil it in water, some in alcohol. In endeavouring to procure a good watch oil I have given up all hopes of ever being able to make an oil to please every watch maker. This is impossible owing to the grounds on which they base their judgments. Oil may be rendered bad by other causes entirely independent of anything connected with the oil, as for instance, there are certain kinds of brass which will destroy the quality of good oil. Cedar wood if applied in any part of a clock case will cause any oil applied to the movement to thicken in a few months.

MEMOIR OF B. L VULLIAMY.

Mr. Benjamin Lewis Vulliamy, born in London, about the year 1780, was descended from a family of high respectability in Switzerland, whence his grandfather Mr. Justin Vulliamy, emigrated to this country, and settled in the metropolis. He became connected with Mr. Benjamin Gray of Pall Mall, married his daughter and succeeded him in business: since that period the appointment of Clock-maker to the Crown, which was held by Mr. Gray, in the reign of George II., has continued in the Vulliamy family. In the performance of the duties of his office, Mr. Benjamin Vulliamy, was frequently in attendance upon George III. at the Observatory at Kew, and thus his son, Mr. Benjamin Lewis Vulliamy, was brought at an early period, into contact with the younger branches of the Royal Family, and there are in existence letters written to him by some of the Princes, when young, which exhibit the esteem, in which they held him. Nor did this feeling cease with their early years, but, on all occasions, when their interference could be beneficial to him, he had only to express his wishes to insure immediate attention. He was however so fully penetrated with this feeling, and so scrupulous in exercising the influence he possessed, that he submitted to the imputation of indifference, rather than prefer the simplest request even for the advancement of his own family.

Her Majesty the Queen, on her accession was pleased to give special direction for the maintenance, during his lifetime, of the patent office which he held: a gracious acknowledgment of his services and those of his father and grandfather, to which he always referred with pardonable pride and gratification.

The notice of the Royal Family, naturally induced that of great numbers of the aristocracy, and there has rarely been an instance of a man engaged in trade being admitted to such intimate communication with so many of the nobility: his sound common sense, his fearless expression of his opinion, and his general bearing, induced confidence, and more intimate acquaintance confirming the preconceived good opinion, he was admitted to an intimacy with many noblemen and gentlemen, of high standing in the scientific world.

Mr. Vulliamy's early years were devoted to the attentive study of his future business: the best authors on the theory and practice of horology passed through his hands: he became intimate with engineers and mechanicians, and learned the points of excellence of other machines to be subsequently engrafted upon his own productions. The works of ancient and modern horologists of this and of foreign countries, became familiar to him, and this combination of theoretical knowledge and practical skill, enabled him eventually to produce the great work for which the name of Vulliamy will long be remembered.

All his productions were remarkable

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for their sterling excellence, but the branch to which he devoted the chief powers of his mind, and the largest portion of attention and time, was the construction of turret clocks, and upon that subject he wrote several valuable pamphlets, which with the example of his works, have tended materially to the improvement of the construction of public clocks in this country. Among the numerous specimens of his mechanical knowledge and artistic skill, may be mentioned the turret-clocks at the New Post Office, St. Martin's-le-Grand, at the Victualling Yard Plymouth, at Windsor and Lowther Castles, at the Churches of Norwood, Leytonstone, and Stratford, the Cathedrals of Calcutta, and Oxford, and at the University Press of the latter city. Into many of these works, he introduced several peculiarities, such as the pendulum to vibrate two seconds; the great length of the pendulum, and the consequent near approximation of its circular arc of vibration to the cycloid, gave obvious advantages, and the considerable weight of the bob, rendered it far less liable to be affected by external causes.* The result of these arrangements, combined with the perfect execution of every part of the work produced, was accuracy of performance in his turret clocks which has rarely been equalled in this country, or on the Continent. It is a known fact that in six months, the clock at Christ Church, Oxford, had never been set and yet had not varied thirty-five seconds. The knowledge of these circumstances induced Sir Charles Barry to apply to Mr. Vulliamy for suggestions for the interior construction and arrangement of the clock-tower in the new Houses of Parliament; and it was by the advice of that eminent architect, that the Government afterwards had recourse to him for a design for a clock to be placed in that tower. To this design Mr. Vulliamy gave all his energies, and it was for a long time his confident hope that the greatest monument of his own art might be united with that of his friend's. The circumstances, under which a competition was induced for the construction of that clock, and the decision arrived at, are well known from the parliamentary papers published on the subject.* It is probable that those who have had the opportunity of examining the original drawings, now deposited in the collection of the Institution of Civil Engineers, may have arrived at other and opposite conclusions. It was considered by Mr. Vulliamy, that the rate of going of the Christ Church clock was a surer guarantee for greater general accuracy than that demanded, that the first stroke of each hour should be true to a second of time, and that a machine which was to move hands of twelve feet in length, exposed to the action of the wind, which would, through them, as levers, affect the movements of the internal parts, was not to be constructed like a drawing-room toy, or as an astronomical regulator. His feelings on the subject were painfully acute. But the mortification he experienced was greatly alleviated, by the kind expressions of sympathy elicited from almost all the eminent clock-makers of Great Britain, and of the Continent, by whom he was universally esteemed and respected.

But it was not only in the scientific part of his business that his eminence was admitted: his taste was refined by the study of the fine arts: his knowledge of architecture, of paintings, and of engravings, was of a character seldom attained by amateurs. His library was rich in works both on construction and ornamental art. His judgment had not been formed from books alone, he had personally visited and was well acquainted with many of the best museums and galleries on the Continent, as well as in his own country. The consequence is to be traced in the perfect keeping and correctness of the general design, and the decorative portions of all his own brighter productions.

Being apprenticed to his father, he received the freedom of the Clockmaker's Company in December 1809, became a Liveryman in January 1810, and was admitted a member of the Court in the month of April in the same year. He served every office in the Court of the

* The pendulum bob of the clock at Lowther Castle weighs 4 cwts.

* Vide Parliamentary Papers.

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Guild, and was five times elected Master. His services were duly acknowledged by a presentation of plate in the year 1850, and it is a touching proof of the deep interest which he took in all that concerned the interests of those of his own calling, that the last act of business he performed, was to receive a deputation of the trade on the subject of the erection of an Asylum for aged and decayed persons, who had been engaged in any branch of the art. Even then the hand of death was on him, and in little more than forty-eight hours afterwards he had passed from this world to his rest.

He was a liberal contributor of models and specimens to the collection of the Clockmakers' Company, and co-operated actively in the formation of their valuable library, where should have been deposited the results of the numerous intelligent experiments made by his grandfather, his father, and himself; they have, however, apparently not been preserved. He was most anxious for the establishment of a school, especially devoted to the study of the science of horology, and where, in addition to the ordinary apprenticeship for acquiring manipulation, the literature of the art could be studied, in order, as he used to express it "to prevent men from repeating the inventions of their grandfathers."

His anxiety for the welfare of his workmen was well known and estimated by all who had the good fortune to be in his employment, and there are numerous instances of his having granted weekly stipends to deserving handy craftsmen, who had in their old age, fallen into distressed circumstances.

He was a Fellow of the Astronomical, the Geographical, and the Zoological Societies, and he had been, since the year 1838, an associate of the Institution of Civil Engineers, into which he was introduced by his Intimate friend Mr. Francis Bramah. He served on the Council, and acted as auditor of Accounts on several occasions, was a very constant attendant at the meetings, contributed some interesting papers to the volumes of the Minutes of Proceedings, took part in the discussions, and was always among the first to contribute, either pecuniarily, or by personal exertions, for the welfare of the Society. He presented two valuable clocks for the Theatre and the Council room, made several additions to the Library, and one of the latest acts of his life was to present to the Institution, a valuable collection of two hundred and seventy volumes of mechanical and horological works, which had been selected with great judgment for his own use, and which form, perhaps, the best collection of books of the class, in this country. The intention of making this valuable gift, was thus announced to the author of this sketch, only eleven days before the lamented decease of the generous donor.

"Pall Mall, *December 28th*, 1854.

"My dear Manby,

"Man that is born of a woman hath but a short time to live, and that I am persuaded is my case. There is not anything like being plain-spoken in matters of business in a straight-forward way. Will the Council of our Society accept legacies, left with conditions attached to them? I am anxious that my horological library should, after my demise, remain intact, and I should like to know whether it would be accepted upon the condition that it should be kept apart from any other books, without deductions or additions. In that case, it cannot be otherwise so well disposed of. The Clockmakers' Company possess the next best collection, but to leave it to them would merely be to give them nineteen duplicates of every twenty books in their library. Come and see me about this matter without delay, &c. Your's very sincerely.

"B. L. Vulliamy."

This expresssion of his wishes, although not recorded in his will, received the most scrupulous attention from Mrs. Vulliamy, his widow, and from his executors, Mr. Ambrose Poynter, and Mr. George Vulliamy, and the Reverend Stephen Rijaud, D.D., and at the Annual General Meeting, the members unanimously agreed to mark their sense of the kind feeling which dictated this bequest, by directing the acknowledgment of the donation in suitable terms, conveying to Mrs. Vulliamy, and the family, the thanks of the Institution, and expressing deep sympathy for the loss they had sustained.

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Mr. Vulliamy had, for several successive winters, suffered severely from attacks of bronchitis, the effects of which had been warded off chiefly by the affectionate care and attention of his excellent lady, but even that, at length, proved ineffectual, and his active and useful life terminated on the 8th of January, 1854, in his seventy-fourth year.

He was a man of accomplished mind, a thorough English gentleman in feeling, appreciating and applauding rectitude of action, and fearless in the expression of his opinion of any deviation from the right path; cheerful, generous, honourable, and affectionate, he will not readily be forgotten by those who knew his worth, and lament his loss.

PAPERS ON THE SEXTANT. No. 2.

By R. Strachan.

Theory of the Sextant.—The sextant, like all other reflecting instruments, depends for its operation upon the simple law of the reflection of light. This law may be thus simply enunciated. Let ABC, (fig. 2,) represent a plane reflecting

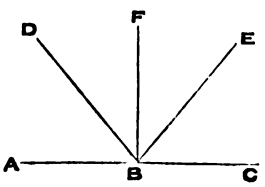

Fig. 2.

surface, and let DB, be a ray of light, which falls upon it at B. Its direction is there changed towards BE; and the law of reflection is, that the angle ABD is equal to the angle CBE; and if BE be perpendicular to the surface at B, BD, BF, and BE lie in the same plane.

Now, refering to figure 3, suppose I to be such a plane reflecting surface. A ray of light, proceeding from the luminous object S, falling upon it will be reflected in the direction IX. Let a second reflector be placed in the path of the reflected ray at H, so as to throw the ray along the line HE; and let the mirrors be so placed that the parts of the ray SI, IH, and HE, lie in the same plane, (say the plane of the paper). Extend the reflecting surface I, by producing it both ways towards Y and M, and extend the surface H towards N and M. Produce SI to D, and EH towards *h*. By the law of reflection, the angle SIY, is equal to the angle MIH; also the vertical angle SIY is equal to the vertical and opposite angle MID. Therefore the angle MIH is equal to the angle MID; that is the angle HID is bisected by the line IM. Similarly the angle XHD is bisected by the line HM. Since HID is a triangle, its exterior angle XHD is greater than the interior angle HID, and since these angles are bisected respectively by HM, and IM, the angle XHM is greater than the angle XIM. Add the angle MHI to each; then the two angles XHM and MHI, are together greater than the two angles MHI and MIH. But XHM and MHI, are together equal to two right angles; therefore MHI and MIH, are together less than two right angles; so HM and IM must meet at M, (by Euclid's 12th axiom).

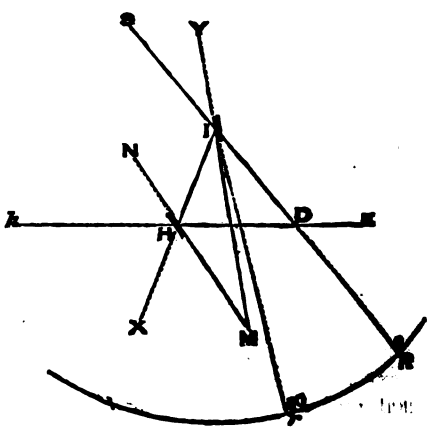

Fig. 3.

Again the angle XHM is equal to the sum of the angles MIH and HMI; and the doubles of equals being equal, the angle XHD is equal to the angle HID, together with twice the angle M.

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But the angle XHD is also equal to the angle HID, together with D. Hence the angle HID, and twice the angle M, are together equal to the sum of the angles HID and IDH. Omit the common angle HID, and there remains the angle IDH, equal to twice the angle M.

If now reference be made to figure 1, it will be seen that I represents the index-glass, H the horizon-glass, and DE the line of sight of the telescope. An eye at E, directed along the line EH, will see an object at *h*, through the transparent portion of the horizon-glass, by direct vision, as for instance the horizon, from which, the object glass gets its name. At the same time the light from an object S, is seen reflected in the same direction. It is evident that the angle SDH is the angular distance between the rays SD and *h*D; and that the angle M, is the angle between the mirrors. Hence the angle between the direction of the rays from two objects, is double the angle between the mirrors of the sextant, when the instrument is arranged so as to make the rays from the objects proceed apparently in the same direction; or which is the same thing, to cause the reflected image of one object to coincide with the direct image of the other object. This is accomplished by placing the index-glass in a suitable position, by moving the radius-bar properly along the arc. When the surface of the index-glass is parallel to that of the horizon-glass, the angle M vanishes, and the angle described by the mirror, in moving from this position, being alternate to the angle M, is equal to it. As the index-bar and mirror move together, they describe similar arcs of circles; hence the angle moved through by the index-bar measures the angle between the mirrors.

The measurement sought being the angle between the rays, or angle D, which is double that between the mirrors, each degree on the *arc* is counted as two degrees. The *arc* of the instrument, is a little more than 60° of its circle, whence the name *Sextant*, but it is graduated to 120 degrees.

Conditions of Precision.—The theory of the sextant, supposes the fulfilment of the following conditions:—

1st. The arc, or limb, should be plane and truly centered, with the axis of the index-glass placed truly in the centre of the arc, and at right angles to the plane of the instrument.

2nd. The surfaces of the index-glass, and horizon glass, should be perfectly plane, parallel to each other, and perpendicular to the plane of the instrument.

3rd. The optical axis of the telescope, should be parallel to the plane of the instrument.

4th. The shade-glasses should have parallel surfaces, and be set perpendicular to the plane of the instrument.

5th. The index-bar should be rigid.

6th. The graduations on the arc should be correctly engraved.

Any of the conditions being imperfect, must necessarily be productive of error, in the indications of the sextant.

ANSWER FROM THE GOLDSMITHS' COMPANY,

TO THE

RESOLUTIONS PASSED AT THE PUBLIC MEETING AND HANDED IN BY THE DEPUTATION.

9th January, 1865.

Sir,—I am directed by the Prime Warden and Wardens of the Goldsmiths' Company, to inform you that they have given an attentive consideration to the matters of complaint, relative to which a deputation from the British Horological Institute, waited on them at Goldsmiths' Hall, on the 6th inst.

The complaints are mentioned in a written paper which you handed to the Prime Warden on that occasion, in which paper the remedies suggested (and which are the same as were made at the meeting) by the gentlemen who addressed the Wardens, are specified.

They are, that the Goldsmiths' Company should adopt the French system of Trial by Touchstone, and the Skeleton Stamp, also that the charges for marking should be according to the work actually done.

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At the meeting the gentlemen who took the most prominent part in addressing the Wardens stated with the utmost confidence, that Gold watch-cases manufactured in France were assayed by the Touchstone, and not by fire, by which means the manufacturer was able to send his work to the assay office in a finished state, and the injury occasioned by taking the scrapings for the assay was avoided, and upon the assumption that this was the fact, the arguments which were used to induce the Wardens to adopt the same system were founded.

I have to inform you that the statements so made are altogether erroneous.

All watch-cases manufactured in France, are obliged by law to be assayed by fire and by means of the Cupel, the manufacturer is obliged to send them in an unfinished state, they are scraped for the assay in like manner as in England, and about the same quantity of Gold is taken for that purpose.

I send you extracts of the French laws bearing on this subject, for your further information.

" Suivant l'article premier de la decision ministérielle du 15 Novembre les essais a la coupelle doivent continuer d'avoir lieu *pour les montres*, et pour tous les autres ouvrages d'or et d'argent susceptibles de cette épreuve."

Circ d'l'adm: des monnaies du 26 Decembre, 1822.

" 31. L'essai sera fait sur un mélange dés matières prises sur chacune des pièces provenant de la même fonte, les matières seront grattées ou coupées tant sur les corps des ouvrages que sur les accessoires, de manière que les formes et les ornemens n'en soient pas détériorés."

" 32. Lorsque les pièces auront une languette forgèe ou fondue avec leur corps, c'est en partie sur cette languette, et en partie sur le corps de l'ouvrage que l'on fera la prise d' essai."

Loi du 19 Brumaire an VI.*

The Wardens are of opinion that it is inexpedient that our laws should be altered so as to permit watch-cases to be assayed by the Touch, a method by which the quality of Gold can only be approximately ascertained, even by the greatest skill and experience.

The law obliges the assayer to ascertain that those manufactures which are required to be assayed and marked, are of the standards allowed by law, and the Wardens consider it is for the public advantage, that these laws should be maintained.

The Wardens do not think it expedient to change the character of the marks by employing a Skeleton Mark. The English marks are known in every part of the world, and the Wardens consider it very doubtful whether it would be for the benefit of the English trade generally, that their character should be altered. Indeed they have reason to believe that the largest watch-case manufacturers would not approve of a change in the marks, such as has been suggested.

With regard to the charges for Assaying and Marking, I am directed to say, that the financial state of the assay office, from which the Goldsmiths' Company derive no profit, does not admit of their reduction at the present time; a reduction of 6*d.* on every gold watch, or one-third of the present charge, would only give £627 5 6 in respect of all the cases marked at Goldsmiths' Hall, during the past year, which sum, although important to the assay office, would be a very insignificant relief to the trade.

The Wardens are of opinion that some improvement may perhaps be made in the manner of scraping watch cases for the purpose of the assay; they think also that the assays may be made from a smaller quantity of gold than heretofore, and to these points the Wardens are directing their attention.

* "According to the first article of the ministerial decision of 15th November, the assay by the cupel should be continued *for watches*, and for all other works of gold or silver susceptible of this proof." Circular from the administration of the Mint, 26th December, 1822.

" 31. The assay shall be made upon a mixture of materials taken from each piece proceeding from the same melting, the materials shall be scraped or cut as well from the body of the works as from their accessories, in such a manner that their forms and ornaments may not be deteriorated."

" 32. When the pieces have a pendant forged or melted with their substance, it is in part upon the pendant and in part upon the body of the work that the assay shall be made."

Law of the 19th Brumaire, year VI.

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The Goldsmiths' Company are always anxious to exercise the functions which are vested in them for the protection of the public, so as to impose as little inconvenience and restraint on the manufacturers as possible, and they believe that they have credit from the most respectable goldsmiths and silversmiths of the Metropolis for so doing. I am, Sir, your obedient Servant, Walter Prideaux.

To Valentine Knight, Esq.,
President of The British Horological Institute.

SOME FACTS ABOUT DIAMONDS.

"A letter was lately published from Sir David Brewster, on a curious optical phenomenon, that had occurred in the construction of a diagonal lens. The diamond, previous to working, had all the appearance of internal brilliancy; but, after being polished, it presented a series of stratified shades, which rendered it useless for the required purpose. It afterwards appeared that lapidaries were acquainted with this appearance, which rendered them extremely unwilling to take the risk on themselves of cutting up diamonds for optical purposes. On a minute examination of this phenomenon, it appeared that these different shades occurred in regular strata, each section being about the one-hundredth part of an inch, and each stratum having a different focus, and being of a different degree of hardness and specific gravity. The inferences drawn from the above facts were—that the diamond was a vegetable substance, and that its parts must have been held in solution, and subjected to different degrees of pressure at different stages of existence. If, on the contrary, as it has been generally believed, it is subject to the laws of crystallization, its crystals must necessarily be homogeneous.

"The diamond, being the hardest of all substances, yields to no file, scratches all other minerals, and is not touched by any. This character has become the most important of the diamond, since the late discovery of the amorphous or compact diamond. It is very frequently tinged light green, but more rarely with orange, red, blue, or black; but in setting, these shades disappear, more particular in the smaller diamonds; but there are also known diamonds of rose and pistachio-nut green colours. The blue colour is very rare. The blue diamond of Mr. Hope, is one of extreme beauty and rarity, and is of immense value; the yellow diamond in the Museum of Natural History, in Paris, is likewise very remarkable for its colour and size. The black diamond, which is perfectly black, although plainly crystallized, occurs most frequently in small bristled balls, but crystalline points; the crystals are very small, grouped together in an irregular manner, and extremely refractory to the cut; it is considered the hardest of all diamonds. The green diamond is also very rare, but I have seen some beautiful specimens in the Jardin des Plantes, and in Freiburg, the first in the cabinet of Abbe Hauy, and the latter in the cabinet of Werner.

"In Russia, the first diamond was discovered in July, 1829, by Humboldt and Ross, when on their journey to Siberia, on the west side of the Uralian mountains, in the gold-washing establishments of Krestowosdwisheaski, belonging to Count Schuwalow. The locality, in connection with the other circumstances of the place where the diamond was found, bears a striking resemblance to the diamond district of Brazil. The predominating rock of the spot on the Uralian mountains is a quartzose chlorite, talcose schist (itacolumite), with an admixture of iron pyrites and mica, wherein we find beds of red oxide of iron, talcose schist, limestone, and dolomite.

"At a most extensive sale of diamonds, which took place in the summer of 1837, at the auction of Rundell and Bridges, London, there were twenty-four lots put up, which produced the sum of £45,000. Some of the prices were as follows:—The celebrated Nassak diamond, which weighs three hundred and fifty-seven and a half grains, and is of the purest water, was purchased for £7,000. It is considered to have been sold at a price considerably under its value. A magnificent pair of brilliant ear-rings, weighing two hundred and twenty-three and a half grains, formerly the property of Queen Charlotte, were bought for £11,000, a price infinitely below their usually estimated value. A sapphire, seventy-five and a half carats, set with brilliants for a broach, £500.

"According to Spix and Martius, there have been produced in Brazil, from 1772 to 1818, 1,298,037 carats of diamonds—that is, in the time of the Royal Administration; but that during the lease, only 1,700,000 carats were produced, which together make 2,998,037 carats, or 1,301¼ pounds, thus averaging from fourteen to fifteen pounds per year; those brought into market by contraband being excepted.

"The largest diamond is in the possession of the Grand Mogul, and according

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to Tavernier, resembles in form and size half a hen's egg. Its weight is two hundred and ninety-seven and three-sixteenths carats. It was found in 1552, in the mine of Colore, a short distance to the east of Golconda, and is valued at 11,723,000 francs. It is cut as a rose-diamond, and is perfectly limpid, with the exception of a small flaw at the end of the girdle."—From *Feuchtwanger's* Treatise on Gems.

Correspondence.

STEEL ESCAPE-WHEELS.

To the Editor of the Horological Journal.

Bridgnorth, *February 3rd*, 1865.

SIR,—The majority of your readers will read Mr. STORER'S paper "on wheels" with pleasure and acquiescence, I doubt not.

May I be allowed to make a suggestion?

I have been struck in reading the article above-mentioned, by the *stand-still*, if I may so speak, at which English watch-making has arrived, or rather the stereotyped make of the English Lever. Why do not our makers adopt the steel escape-wheel?

I think the answer is—that we don't like to depart from usage.

Now Sir, if steel were used instead of brass, the wheel when finished would be much superior in every respect, without the risk of flaws in the metal and disappointment after a large expenditure of time and trouble. Any one who will take up an ordinary Geneva horizontal escape-wheel and examine it, will agree that *it can be done*. Every one knows of course that the Swiss have long adopted the steel escape wheel for their levers, with a variation in the shape of the tooth, which I am disposed to think superior to ours.

I am glad to see that minute particulars such as Mr. STORER has brought forward in his paper, are finding their way into the Journal, as I am convinced that the more practical the nature of the reading, the more popular will the Journal become. Yours respectfully, ROBERT HOPWOOD.

NOTE.—At the close of the fifth paragraph of the article upon wheels, in the last number, after the word strength, *read*, "and the length being one ninth of the wheel's diameter will give ample room for the dip of the angle pallet."

In the next paragraph the sentence should be pointed at the word centre, instead of process. E. STORER.

To the Editor of the Horological Journal.

Hotel Chauvain, Nice, *15th Feb.* 1865.

Sir,—Your Journal penetrates to the remote parts of the earth. Your notice of the time-guns in Scotland, and the north of England, in a recent number, induces me to send you the few lines below, descriptive of my exertions in the same direction. The beautiful weather and brilliant nights we enjoy here are highly favourable to my favourite astronomical pursuits; if you think a short notice of them worthy a corner in your Journal, pray insert the following paragraph, if not, throw it into the fire. I am, Sir, your obedient Servant,

THOS. COVENTRY.

TIME-BALL AND TIME-GUN AT NICE, FRANCE.—An English amateur astronomer has established a time-ball on the roof of his hotel, where he has a small observatory. The town is commanded by a conical hill on which are the ruins of an old castle. The guardian of these ruins is an old artillery-man, and serves well to touch the fusee of a cannon at the first motion of the time-ball, which he can see from the castle. At five minutes before noon, the ball is drawn to the top of a high pole, visible to the whole town; at noon exactly the ball is let down, suddenly at first, and gradually afterwards. At the first motion of the ball, the report of the cannon startles the 60,000 inhabitants and echoes for miles through the surrounding hills, carrying the exact time of midi to the numerous villas in the neighbourhood. All business and pleasure is for the moment suspended, and every watch is turned into a chronometer. The advantage of this standard of time to a population that has hitherto been regulated by rough sundials is immense, and is at length, after a period of four years, duly appreciated. Much opposition was at first experienced at the introduction of mean time; and the discharge of a gun in a garrison town for non-military purposes was considered a great infringement of conservative principles. It was only on appeal to high authorities in Paris that this boon was conceded, and then only on condition that every expense connected with it should be defrayed by the owner of the time-ball, which has been cheerfully complied with. This is certainly the first introduction of anything of the kind in France, beyond a morning and evening gun in seaport towns, but it is only wonderful how so great a public benefit can be so generally neglected.

Sir,—Can you inform me, and others in the trade, when we may expect Mr. COLE'S promised book on Horology, which aroused our expectations about five years ago, and was largely subscribed for. Yours &c.

Coventry. ON THE WATCH.

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Correction of the Time obtained by Observation of the Sun, in order to have the Time by Clock to the nearest *minute*; for any Year.

Month	Jan.	Feb.	Mar.	April	April	May	June	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Dec.
Day	Add. Min.	Add. Min.	Add. Min.	Add. Min.	Sub. Min.	Sub. Min.	Sub. Min.	Add. Min.	Add. Min.	Add. Min.	Sub. Min.	Sub. Min.	Sub. Min.	Sub. Min.	Add. Min.
1	4	14	13	4		3	3		3	6	0	10	16	11	
2	4	14	12	4		3	2		4	6	0	11	16	10	
3	5	14	12	3		3	2		4	6	1	11	16	10	
4	5	14	12	3		3	2		4	6	1	11	16	10	
5	6	14	12	3		4	2		4	6	1	12	16	9	
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7	7	14	11	2		4	2		4	5	2	12	16	8	
8	7	15	11	2		4	1		5	5	2	12	16	8	
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25	13	13	6		2	3		2	6	2	8	16	13	0	
26	13	13	6		2	3		2	6	2	9	16	12		1
27	13	13	5		2	3		3	6	1	9	16	12		1
28	13	13	5		3	3		3	6	1	9	16	12		2
29	14	13	5		3	3		3	6	1	10	16	11		2
30	14	—	4		3	3		3	6	0	10	16	11		3
31	14	—	4		—	3		—	6	0	—	16	—		3

The Equation of Time is the difference between *apparent* time and *mean* time, and serves therefore for the conversion of either time into the other. Clocks, (Siderial Clocks excepted) are adjusted to *mean* time. It is usual to speak of setting a Watch or Clock by a Sun-dial which, when properly constructed and placed exactly in the meridian of any place, shows *apparent Local Time* at that place. But this is not a very accurate mode of adjusting a Watch or Clock to correct *mean* time: for, besides the uncertainty of the Sun-dial being placed exactly in the meridian of the place, there is great difficulty in reading the best constructed Dial to the nearest minute, the Sun's shadow never appearing sufficiently well defined for this purpose. The best method therefore is by transits of the stars over the meridian, or by *apparent* time derived from an altitude of the Sun, and applying the *Equation of Time*, which will give *mean* time at the place of observation, sufficiently correct for all practical purposes. Then if Greenwich *mean* time be required, add the difference of Longitude in time, if the place of observation be West, but subtract, if East of Greenwich.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., JANUARY, 1865.

11, *Offord Road, N.*

Days of the Month.	Barom. reduced to 32° F. and the sea level.	Temperature in the Shade. At 9 a.m.	Highest in the previous 24 hours.	Lowest during the previous 24 hours.	Rainfall.	Wind. Direction.	Wind. Force (scale 0 to 12)	Weather. At 9 a.m.	Weather. During the next 24 hours.
	Inches.	°	°	°	Inch				
1	29·937	32	37	30	0·20	NE	1	s	bc, b
2	·915	27	37	24	—	E	1	m	m, s
3	·493	34	37	25·5	0·06	N	1	om	om
4	·854	44·5	44·5	29·5	—	W	2	o	om
5	30·142	42	48	37	—	W	3	o	o, r
6	29 986	39	49	38	0·32	WSW	7	c	c, b
7	30·386	34	42	31	—	W	2	c	c, o
8	30·099	40	43	32	—	WSW	5	om	omr
9	29·816	40	47	39	—	SW	3	c	oq
10	·808	49·5	50	39	—	SW	5	c	o, r, c
11	·884	44	50·5	42	0·02	WSW	3	o	omr
12	·296	46	48	43	—	S	6	o	rh, s
13	·130	35	48	32	0·77	W	4	cb	o, rr
14	28·636	42	46	32	0·47	WSW	10	o	or
15	29·125	38·5	46	37	0·03	W	4	o	bc
16	·022	37	46	33·5	—	W	4	o	c, or
17	·175	33·5	42	32	0·04	W	2	o	c, bc
18	·359	33	38	29	—	W	2	o	omr
19	·444	35·5	38	31·5	0·02	W	1	m	om
20	·604	33	37	30	—	WSW	2	om	om
21	·679	27	37	25	—	—	0	f	ff
22	·598	28·5	30	23	—	—	0	o	c, b
23	·879	30	34	25	—	WNW	1	f	f, s
24	·640	34	34	27	0·01	E	1	o	o, s
25	·722	33·5	36	32	0·01	ENE	2	o	o, ss
26	·377	34	35	32	0·27	ENE	1	r	rr, ss
27	·031	33	34	32	0·89	NE	6	s	ssq
28	·825	28	33	26	0·45	NW	2	bc	bc
29	·947	23·5	35	19	—	N	1	m	cm, s
30	·303	34	36	21	0 20	ESE	2	s	r, m
31	·347	40	40	33	0 11	SW	2	cm	m, rr
	29·596	35·7	40·6	31	3·87	s73w	1·6	—	Means.

6th, a gale from WSW.

14th, a very severe gale from SW to W; the anemometer at Greenwich registered a pressure of 29lbs on the square foot, that at Liverpool 21lbs.

21st, fog throughout, but remarkably dense from 3 to 11 p.m.

Jottings. Rain has a purifying action upon the air, hence the effect upon the public health resulting from the scarcity last year. Moisture with a high temperature is oppressive but moisture with a lower temperature improves the air. In relation to ventilation, "chemical action, and with it the feeling demand a certain amount of warmth first and above all things. No function can go on without it. You may live hours, days, or years in badly ventilated places with more or less discomfort and danger, but a draught of cold air may kill like a sword. In railway carriages and in houses also the great instinct of man is first to be warm enough, and he is quite right. Such a universal instinct is not to be sneared at."—DR. ANGUS SMITH.

EQUATION OF TIME TABLE

For MARCH, 1865.

Day of the Week.	Day of Mth.	At APPARENT NOON. Equation of Time to be *added* to Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Wed ..	1	12 32·37	0·500	12 32·47
Thurs .	2	12 20·11	0·521	12 20·22
Fri	3	12 7·36	0·541	12 7·47
Sat	4	11 54·12	0·561	11 54·23
Sun ...	5	11 40·41	0·580	11 40·52
Mon ..	6	11 26·26	0·598	11 26·37
Tues...	7	11 11·69	0·616	11 11·80
Wed ..	8	10 56·70	0·633	10 56·82
Thurs .	9	10 41·33	0·649	10 41·45
Fri	10	10 25·60	0·663	10 25·72
Sat	11	10 9·54	0·676	10 9·65
Sun ...	12	9 53·16	0·688	9 53·27
Mon ..	13	9 36·48	0·699	9 36·59
Tues...	14	9 19·54	0·710	9 19·65
Wed ..	15	9 2·36	0·720	9 2·47
Thurs .	16	8 44·97	0·729	8 45·08
Fri	17	8 27·38	0·737	8 27·48
Sat	18	8 9·61	0·743	8 9·71
Sun ...	19	7 51·70	0·749	7 51·80
Mon ..	20	7 33·67	0·754	7 33·77
Tues...	21	7 15·53	0·758	7 15·62
Wed ..	22	6 57·30	0·761	6 57·38
Thurs .	23	6 39·00	0·764	6 39·08
Fri	24	6 20·64	0·766	6 20·72
Sat	25	6 2·25	0·767	6 2·33
Sun ...	26	5 43·85	0·767	5 43·92
Mon ..	27	5 25·44	0·767	5 25·51
Tues...	28	5 7·05	0·766	5 7·11
Wed ..	29	4 48·69	0·764	4 48·75
Thurs .	30	4 30·37	0·762	4 30·43
Fri	31	4 12·12	0·759	4 12·18

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LECTURE ON THE GREENWICH SYSTEM OF TIME SIGNALS,*

Delivered in the Society of Arts' Room, February 24, 1865, before the Members of the British Horological Institute.

By William Ellis, Esq., F.R.A.S., of the Royal Observatory, Greenwich.

George Biddell Airy, Esq., Astronomer Royal, in the Chair.

Mr. Chairman and Gentlemen :—

I appear before you this evening at the invitation of the Council of the British Horological Institute, to give you an account of some of those operations which in their relation to Horological Science may be supposed to be interesting to the Members of a Society having for its object the promotion of the science and practice of Horology. I refer to the system of Time Signals as established at and in connexion with the Royal Observatory, Greenwich.

I may say at the outset that the whole of the system is automatic. The apparatus is itself distributed in various places but works together as one complete whole. Time Signals pass from a clock in the Royal Observatory to different points in London, from which they become again distributed in London, and, by means of various of the telegraphic lines, extensively also throughout the country, and clocks on many important lines of railway are constantly regulated by them. Signals pass also to control clocks and correct clocks, and signals are received from corrected clocks, time balls also are discharged, and all by automatic means. Some attention is necessarily required; the Greenwich clock must for instance be set each morning to exact time; and, in

Explanatory Note.—In accordance with a resolution of the Council of the British Horological Institute, a letter was addressed to Professor Airy, the Astronomer Royal, asking him "whether it would be possible for the Institute to have the favor of a lecture on the method of treating chronometers at the Greenwich Observatory, or the application of electricity to the uses of regulating clocks, or any subject connected with the purposes of the Institute, given by some gentleman from the Observatory, &c."

"In reply," the Astronomer Royal said, "I have to state that I have communicated on this matter with Mr. Ellis, of the Royal Observatory, to whom all the operations of Treatment of Chronometers and Distribution of Time Signals are immediately confided; and that Mr. Ellis expresses his entire willingness to accede to the wish of the Council, and Mr. Ellis's knowledge of the entire subject is so complete that I do not doubt that a lecture from him will be very acceptable."

Upon the receipt of this highly esteemed favor from the Astronomer Royal, Mr. Ellis was communicated with, and he fixed the subject of his lecture and the time of delivery. The large number of members who were desirous of attending so important a lecture, rendered it expedient to seek for a larger room than the Institute possesses, and the Council were happy in obtaining permission from the Society of Arts, for the lecture to be delivered at their Hall in the Adelphi. Meanwhile the Right Honourable the Lord Mayor had consented to take the chair. But on the day of the lecture, his Lordship addressed the following note to Mr. Jones, V. P.

"Mansion House, London, *Feb.* 24, 1865.

"My dear Sir,—I much regret that I shall not be able to attend at the rooms this evening, my presence being required at Southampton this afternoon. I assure you I should have felt great pleasure in being present, and presiding on the occasion. I am, my dear Sir, yours truly, Warren S. Hale."

Hence it happened a few moments before the commencement of the lecture, when the Astronomer Royal was seen to enter the room, and to take a seat as one of the audience, that two of the vice-presidents solicited him to occupy the chair.

In acknowledging the obligation of the Institute to the Astronomer Royal, it is necessary to state this, for undoubtedly he would not have consented to preside had it not been on account of the emergency.

It is but right to state that the instruments used by the lecturer, which were of a most elaborate and valuable description, were kindly lent by C. F. Varley, Esq., Electrician to the Electric and International Telegraph Company, Telegraph Street, E.C., and by Mr. Shepherd, 53, Leadenhall Street, E.C., also by the Astronomer Royal, and F. A. Abel, Esq., of Woolwich Arsenal, also kindly supplied some fuzes to illustrate the firing of the Newcastle and Shields time guns.—[Ed.]

* It is proposed to give a full report of the lecture here, portions of it having on account of its length been omitted at the time of delivery.

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the case of a time ball, it must of course be first raised ready for discharge; but so far as concerns the mere distribution and reception of signals, including the necessary switchings of wires, &c., all goes on without any person at any place having occasion to touch any of the apparatus concerned.

From the very first establishment of the various telegraphic systems in England, the Astronomer Royal had always kept in view the desirability of connecting the Royal Observatory with those systems for various purposes, among others for the distribution of Greenwich time. About the year 1849, he came into correspondence with Mr. C. V. Walker, Telegraphic Engineer of the South Eastern Railway Company, who on his part was equally desirous to place the South Eastern telegraphic system in communication with the Observatory, and the necessity for other communications having also arisen, the Astronomer Royal obtained the permission of the Directors of the South Eastern Railway Company (on the representation of Mr. C. V. Walker) to carry wires on the poles of their railway to London Bridge, from which place communication with other points could be more readily obtained. This connexion was established in the year 1852: at first the wires were laid underground through Greenwich Park and across Blackheath to the Lewisham Station of the S. E. Railway, being continued from thence along the railway to London. In a few years however the buried wires became so defective, on account of the decay of the external gutta percha covering, that their use was given up, and overhouse wires, erected with the assistance of the London District Telegraph Company, were taken into use instead; these wires are still used; they pass over the Park and over the houses in Greenwich to the Greenwich Railway Station, continuing then along the railway to London.

In the same year that galvanic communication was thus established (1852) the Normal Mean Time Clock of the Observatory was erected. This clock, placed in what is called the Ball Lobby, is one of Shepherd's construction; it is worked entirely by galvanism, and is kept constantly adjusted to Greenwich mean solar time. It is the central clock of the whole Greenwich system, time signals originating from it being received eastward, southward, westward, and northward, as far even as Glasgow. But as well as being employed to distribute thus time signals (to which I shall have presently to refer more at length) it is also used to work various other clocks on Shepherd's plan (five in all) situated in different places within the Observatory building. One of these clocks (a large one) is fixed in the external wall of the building near to the entrance gate, for the use of the public; another is placed in the chronometer room for use in the daily rating of chronometers, either belonging to the Royal Navy or otherwise on trial; another (a small one) is placed on a certain desk in the computing room and is used for a purpose to be hereafter mentioned; the two remaining clocks are for ordinary use in different parts of the Observatory. There is, in addition, one other clock worked in with the Observatory system, it is one situated in the Observatory belonging to the Royal Hospital School, the necessary connecting wires for this clock passing under the ground of Greenwich Park. All these clocks move in sympathy with the normal clock and depend on the one pendulum of the normal clock, that is there is but one pendulum for the whole series, and any acceleration or retardation of this one pendulum accelerates or retards the whole series of clocks. Now to explain the action of these clocks; and firstly, as respects the pendulum. This is maintained in vibration in the following manner: as it moves to the right (to a person facing the clock) it comes into contact with a slender brass spring (mounted on a block of ebonite for insulation); this contact (the surfaces at such points of contact being always faced with platinum) completes a galvanic circuit, allowing a galvanic current to pass through the coils of an electromagnet placed in the circuit; the armature of the magnet being attracted raises a rectangular lever carrying a small weight, and this lever being caught by a detent becomes locked. As the pendulum swings away towards the left the contact

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is broken, and the armature falls away, leaving the weight lever locked until the pendulum continuing its vibration towards the left, a pin on the rod lifts the detent and leaves the weight lever free, which being at the same instant received on the pendulum gives it a slight impulse. The pendulum returning to the right again completes the circuit, and the order of operations already described is again repeated. Thus the action of the pendulum (a seconds' pendulum) is maintained, and as long as the galvanic battery remains in good order it will so continue to vibrate. So much for the pendulum. For working the clocks themselves two other galvanic batteries are provided from which galvanic currents, positive from one battery, and negative from the other, alternately pass to the coils of two electro-magnets in the normal clock and to two in each of the other clocks. The poles of these electro-magnets stand upwards, and the time of passage of the currents through the coils is determined by contacts made by the pendulum with slender insulated brass springs, one on each side of the pendulum. These opposite currents at successive seconds cause the electro-magnets in the several clocks to attract and repel alternately two horizontal bar magnets, giving to the axis on which they are placed an oscillating motion. Pallets on an anchor fixed to this axis act upon the teeth of a wheel and drive it forward. The axis of this wheel carries the seconds' hand, and from this axis by a proper train of wheels motion is communicated to the minute and hour hands. Thus the clocks all advance simultaneously, their movements being entirely controlled by the one pendulum as already mentioned. The springs in the normal clock which make contact with the pendulum are very light, and are placed very near to the top of the pendulum, just below the pendulum spring, and the performance of the clock is on the whole good.

We have thus a system of sympathetic clocks worked from a single pendulum. Suppose now that the clocks all show exact Greenwich mean time. Sooner or later they will begin to deviate from true time. For if correct to-day a small deviation will be found to exist to-morrow, although its amount may be a small fraction of a second only. It is therefore necessary to determine the amount of error daily, and also provide means for accelerating or retarding the governing pendulum so as quickly to bring it again to time. We will first consider the manner of determining at any given time the amount of deviation. This leads me incidentally to speak of the system of Sidereal galvanic clocks and the Chronograph; of these however my account must be brief. You are probably aware that in observing the meridian transit of a star with the transit instrument it was formerly the practice at Greenwich (as it is still the ordinary practice at many places) for the observer to listen to the beats of the transit clock, count the seconds mentally, estimate the times at which the star passed the threads in the telescope, and write in a note book the estimations as made. This is known as the "eye and ear" method of observing as distinguished from the "chronographic" method. But at Greenwich all is now changed, and the chronographic method is alone used. In this method the meridian transits made with the present transit circle are registered by galvanism, the recording instrument being a Chronograph specially devised by the Astronomer Royal. This Chronograph has been in use since the year 1854, and consists of a clock which drives a cylinder on which the galvanic record is made. The motive power of the clock is a weight; it has a pendulum with conical motion, and an application of Siemens's Chronometric Governor. Further description of the clock itself I cannot give without going too much into detail. One spindle of the clock gives motion to the brass cylinder which is about 20 inches long and 12 inches diameter, and on it is fixed the paper which receives the galvanic record. Another spindle gives motion to two long screws running the whole length of the cylinder: on these screws a frame travels carrying two electro-magnets. Each armature when attracted causes a sharp point to puncture the paper. One magnet is used to record the seconds of the transit clock, the other being for record of the transits observed. The wires from

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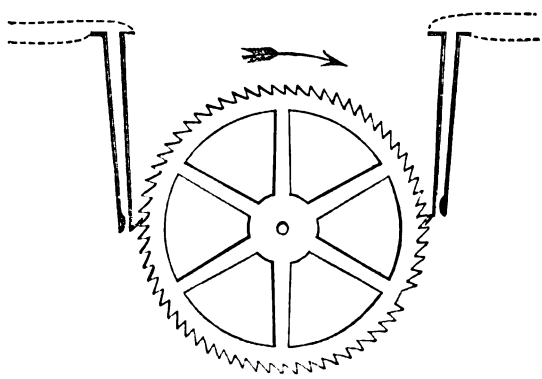
one electro-magnet consequently pass to the transit clock (an ordinary weight clock) the galvanic contact in the clock being made as follows. A wheel having 59 teeth (or rather 60 teeth with one cut away) is set on the escape wheel spindle, and each time that the wheel moves forward, a tooth presses together two slender springs set in a proper position to be thus acted on. At each beat of the clock the circuit is thus for an instant closed and a corresponding puncture made in the paper on the revolving cylinder. One tooth being cut away causes in each minute a loss of one current, and the omission of the corresponding puncture on the cylinder marks with certainty the commencement of each minute. The annexed diagram shows the arrangement now described: the springs on the right hand are those used for the chronograph contact, those on the left being used for a purpose to be presently alluded to. Each pair of springs has means of adjustment in both the horizontal and vertical directions, as well as power of changing the distance between the two springs in each pair. Dotted lines in this and all diagrams represent the communicating wires.

The wires from the other electro-

Fig. 1.*

Contact wheel and springs in Transit Clock.



magnet pass to the transit circle, and terminate at the eye end of the instrument, where there is a finger piece, to enable the observer to complete the circuit at pleasure. To observe the transit of a star, by the aid of the chronograph, the observer merely keeps his hand near the finger piece, which he presses as he sees the star cross each thread in the telescope: each time the circuit is so completed a puncture is made on the revolving cylinder. Arbitrary signals given by the observer, at some definite time, fix on the cylinder the absolute time as respects hours and minutes; the seconds provide for themselves, by means of the omitted puncture at the commencement of each minute, as already mentioned. The puncturing points have each a spring motion, which allows them after entering the paper, to yield a little with the paper as it turns, and so prevent the tearing of an elongated hole in the paper, during the short interval which elapses between the descent of either of the points, and its almost immediate withdrawal. From the description which has been given, it will be remarked, that, as the frame carrying the electro-magnets slowly travels horizontally along the cylinder as the punctures are made, the punctures form on the cylinder a spiral running from one end of the cylinder to the other.

The contact springs shown on the left hand side of the contact wheel in the diagram are used to drive a small galvanic clock, fixed to the great equatoreal: to regulate, on Jones's plan,† a clock (having independent going power of its own) used in connexion with the great equatoreal; and to drive another small

* This wheel should have been drawn with 60 teeth, counting the one cut away.

† Of Jones's plan of regulation, it will be necessary afterwards to speak.

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galvanic clock, placed in the computing room, near to the small mean time clock already specially referred to. As these clocks receive only 59 currents in each minute, instead of 60, (on account of one tooth being cut away in the contact wheel, as already mentioned) the seconds wheel in the two clocks *driven* by the galvanic current is made with 59 teeth, equally distributed round the circumference, instead of 60, the dial being divided to correspond; by this the inconvenience of the lost tooth is obviated; at that beat of the transit clock at which no current is transmitted, the seconds' hand in these two clocks stands still; at every other part of the circle the particular second is correctly pointed out. In these clocks the attraction of a soft iron armature lifts a detent, and drives the seconds' wheel forward, means being provided for preventing the wheel from being driven too far forward. The omission of the one current in each minute is of no importance in the regulated clock.

Thus we arrive again at the mean time system. The small mean time clock represents the normal clock, of which the error is to be found, the small sidereal clock represents the transit clock, of which the error is previously ascertained by astronomical observation, in the following way: in the Nautical Almanac, tables are given showing throughout the year, the right ascensions of certain stars called "Clock Stars," because their positions being known with very great accuracy, such stars can be used with safety to ascertain the error of the sidereal clock, a determination of fundamental importance in an active Astronomical Observatory. The right ascension of a star is, in other words, the time which a Sidereal Clock should, if correct, show when such star is on the meridian exactly. One of these stars then being observed, by the aid of the Chronograph, the time of transit over each thread of the telescope is extracted from the chronograph record, and the mean of all taken; this mean is then corrected for various instrumental errors, small in amount, and finally for "personal equation." This "personal equation" depends on the circumstance, that any two observers will differ in their estimations by a quantity, which in the chronographic method of observing remains very constant, and which usually amounts only to a small fraction of a second. We have thus the true clock time of transit of the star, such as would have been observed, supposing the instrument had been perfect, exactly in the meridian, and the observation made by one particular observer. The difference between this and the right ascension of the star, as given in the Nautical Almanac, is the error of the sidereal clock. A comparison being now made (generally by the method of coincidence of beats) between the small mean time clock and small sidereal clock, as they stand together in the computing room, side by side, and the error of the sidereal clock being known, the true sidereal time of comparison is known. This sidereal time is then converted into mean time, by tables such as are given in the Nautical Almanac, and the difference between the mean time so computed and the time shown by the mean time clock when the comparison was made, is the error of the mean time clock, and consequently of the whole series of mean time clocks.

Having obtained the error of the mean time clocks, the next thing is to accelerate or retard the governing pendulum as may be necessary, in order to correct this error. To effect this, two plans devised by the Astronomer Royal have at different times been used. The first method may be described as follows, and the apparatus still exists, though now no longer employed. An auxiliary pendulum, consisting of a long wire having a small cylindrical brass cup weighted with shot attached to its lower extremity, hangs by the side of the case of the normal clock. A hole cut in the clock case allows a communication to be made between the auxiliary pendulum and the inside of the clock case, and the weighted cup can by turning a lever (not shown in the annexed diagram, illustrating the action of the auxiliary pendulum) be instantly brought into connexion with the rod of the clock pendulum, at a point immediately above the neck of the mercurial jar, so that the two pendulums

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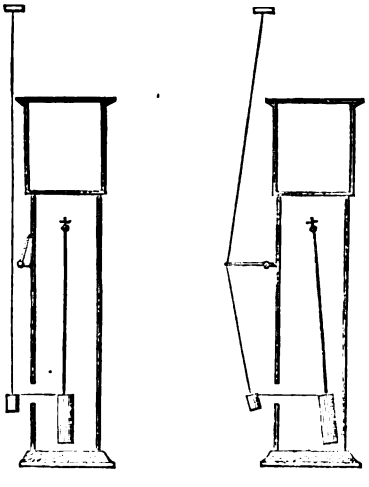
vibrate as one system as shown in the left hand example, in Fig. 2. The auxiliary pendulum being in this position longer than the clock pendulum, the compound system vibrates more slowly than the clock pendulum alone. By changing the point of suspension of the auxiliary pendulum, so as to make it shorter than the clock pendulum, the compound system vibrates more quickly than the clock pendulum alone. The change of the point of suspension of the auxiliary pendulum is made by projecting a brass fork against the wire, in the plane of its vibration, so as to form a new point of suspension. This state of the apparatus is shown in the right hand example of Fig. 2. In the left hand example, the brass fork, not in use, is seen turned up against the clock case. When the desired change in the clock pendulum has been made, the auxiliary pendulum can be detached, as easily as it was attached, and remains hanging by the side of the clock case until again required. The apparatus was arranged so as to effect an

Fig. 2.

Old method of correcting Normal Clock.

Retarding. Accelerating.

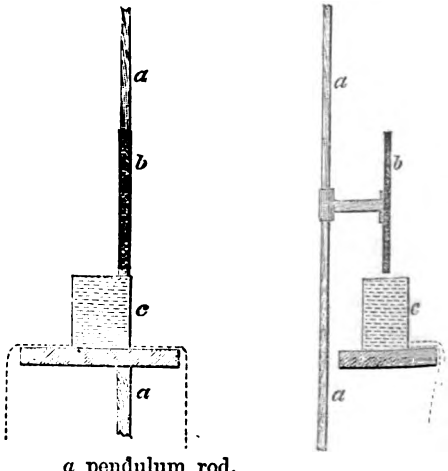


alteration (acceleration or retardation) of one second in one hundred seconds, and this method of correcting the clock was quite effective. It was discontinued only because something more delicate was required when the plan of regulating distant clocks by galvanism (to be hereafter spoken of) was first put into practice. The method now to be mentioned was then devised, and this form of apparatus is that still in use. A permanent bar magnet is fixed in a vertical position on the pendulum of the normal clock, and a coil of wire without iron core, placed also in a vertical position immediately underneath the magnet, is fixed to the clock case. The coil occupies a position such that when the pendulum hangs at rest, the end of the magnet is exactly over the centre of the coil. At every vibration of the pendulum the lower end of the magnet passes close over the upper end of the coil. The arrangement is shown in Fig. 3, which exhibits both a front and a side view. The wires of the coil are led to a commutator placed in the computing room between the two small sidereal and mean solar clocks, (See Fig. 4.) By turning the handle of this commutator to one side, a battery current is placed in connexion with the coil; by turning it to the opposite side the direction of the battery current is reversed: in one case there is attraction between the

Fig. 3.

Present method of correcting Normal Clock.

Front view. Side View.



a pendulum rod.
b magnet, fixed to pendulum rod.
c hollow coil fixed to clock case.

adjacent ends of the magnet and coil, in the other case there is repulsion; when attraction exists, the pendulum being

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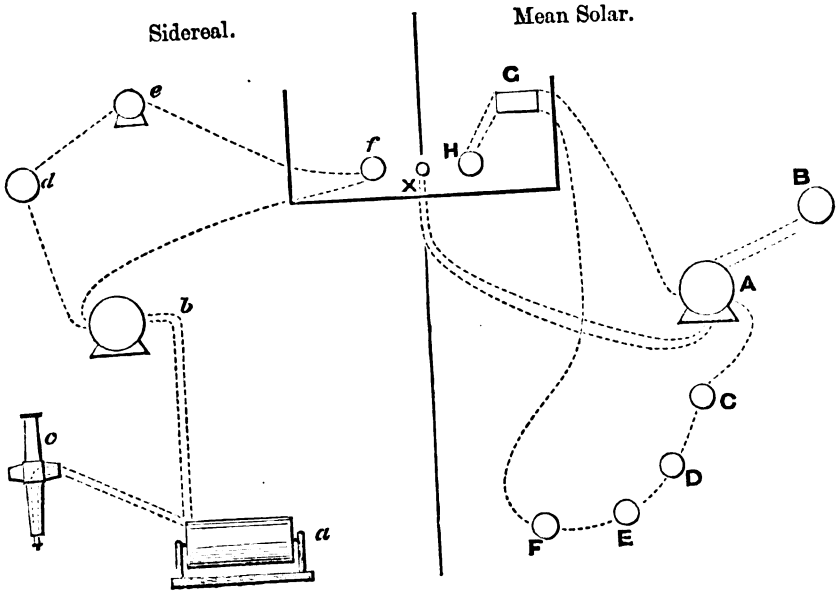
continually pulled towards the centre is accelerated, when repulsion exists, the pendulum being continually driven from the centre is retarded. When the handle of the commutator stands upright, the current is cut off from the coil and no effect is produced on the pendulum. To effect an acceleration or retardation of one second of time, a battery of such strength is at present employed as will produce that amount of change in about ten minutes. The simple coil of wire is used without iron core in order to get rid of the attraction which would exist between the iron and magnet when the apparatus is not in use, as such attraction might be variable. This manner of daily correcting the clock, by magnet and coil, has been in use since the year 1860.

Fig. 4.

Greenwich Galvanic Systems of Clocks.



The annexed diagram, Fig. 4, illustrates the connexion of the sidereal and mean solar systems of clocks. All relating to sidereal time is placed on the left-hand side, and all relating to mean solar time on the right: *a* represents the revolving cylinder of the Chronograph; this receives the record of the transit or sidereal clock *b*, as well as the record of the transits made with the transit circle *c*. An observation of a clock star extracted from the chronograph record and compared with the position given in the Nautical Almanac gives the error of *b* on sidereal time, which error is also the error of the sidereal clocks *d*, *e*, and *f*. The sidereal clock *f* is that compared with the mean solar clock H (which is worked by A through the seconds' relay G); the error found for H is also the error of the normal clock A, as well as of the remaining mean time clocks B (the public clock), C, D, E and F. X is the commutator by which, after their error is found, the mean time clocks are corrected, by action on the pendulum of A. All situated within the black line in the diagram is placed on a certain desk in the computing room. Thus a person seated at this desk can compare together the two clocks, find the error of the mean time clocks, and correct them by the commutator, without having to go away from the computing room itself. The correction of the mean time clocks is made every morning before 10 A.M, excepting on Sunday, on which day it is not made until shortly before 1 P.M.

(To be continued.)

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MEETING OF WATCHMAKERS AND JEWELLERS.

A public meeting of jewellers and watchmakers was held on 22nd February, at the British Horological Institute, Northampton Square, to take into consideration the letter from the Goldsmiths' Company on the subject of scraping and stamping watch cases, R. Webster, Esq., in the chair.

The Chairman, in opening the proceedings, said resolutions were proposed, and a deputation appointed, to wait on the Goldsmiths' Company, with the view of inducing them to revise and alter their present system of scraping and stamping watch cases, and also to reduce the charge for so doing. The deputation waited on the company, and were very courteously received by the prime warden and wardens of the company, and the grievances ably set forth by Mr. Bennett, Mr. Jones, and others; and after hearing them, the prime warden stated that they would take the matter into consideration, and send an answer by letter. That letter he would now call upon the secretary to read, after which he should be glad to hear any remarks they had to make upon its contents.

The Secretary read the letter which appeared in the last Journal.

The Chairman said, by that letter it would be observed the first complaint was denied by the company; with regard to the second, it was not at all satisfactorily answered; and as to the third, that of employing a skeleton mark, they seemed to say it always was a stamp, is the same now, and ever shall be; but whether they felt disposed to submit to that doctrine it was for them to say.

Mr. Jones said the resolution he had to submit was:—"That in the opinion of this meeting the Goldsmiths' Hall has not satisfactorily met the complaints ordered to be submitted to them at the last meeting; that no sufficient answer is made to the allegation of undue charges by referring to the pecuniary condition of the assay office; that the judgment of the case-makers referred to by the Goldsmiths' Hall is no sufficient authority on the question of stamping; that neither the Swiss nor French method of stamping is so destructive to the work as that practised at Goldsmiths' Hall; that the manufacturers of watches who have to trade in competition with the Swiss in all parts of the world are better judges of what will promote their trade than the wardens of the Goldsmiths' Company, who have no connection with the trade." It seemed that the whole arrangement of this stamping and scraping, as well as the price charged, was in the management of four wardens, who had no connection whatever with the business, and it was impossible they could know anything about the question as it affected the watch manufacturers. One of these wardens was a sugar baker, another a refiner, another a silver spoon maker, and the fourth a banker. He thought they would all agree with him that if they wanted to choose four men, who were most incompetent to consider such a case they would most likely fix on those four wardens. In future they would not have to deal with the company, but with the four wardens he had alluded to. He maintained that they had not received that candid answer to their complaints they ought to have received—nay, that they had a right to expect from a body of gentlemen. They ought to have had a clear, lucid answer to each of the charges made, but instead of that the company had preferred to ride off in side roads; they evaded the question, and had not met it as they ought to have done. The complaint made was that their present mode of stamping was injurious to the work, and with the view of assisting the wardens in forming an opinion on the subject, the deputation told them if they looked to France they would find the touchstone was used there as a test for watch cases, and if it satisfied the French authorities as to the purity of the cases, it was sufficient for all commercial purposes in this country, especially as refiners had told him they very often bought gold by the test of the touchstone only. The answer to that was that all watch-cases manufactured in France were obliged to be subjected to the cupel and scraping, but they said nothing about the watch-cases imported from Switzerland, which amounted to three-fourths of the total production, and which were all tested by the touchstone, and the other fourth by the cupel. It would have been much better for them to have acknowledged that three-fourths were tested by the touchstone rather than to have evaded it as they did. Paris was not such a producer of watches as in years gone by; and it was not right for the wardens to fall back on the system adopted in France of using

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the cupel in respect of all cases manufactured there, as anything to guide them in coming to a decision. Further than that the deputation never mentioned cases manufactured in France, but those cases which were used by the watch manufacturers there. Consequently they had a right to affirm that the proposition referred to them, instead of being fairly considered and discussed, was evaded, and that was the reason he said in the resolution he proposed that the answer of the Goldsmiths' Company was unsatisfactory. It was also unsatisfactory for the Goldsmiths' Company to tell the watch manufacturers that the pecuniary condition of the assay office did not warrant their reducing their charge for assaying and stamping. They had nothing to do with that. The charge was more than double that allowed by law, for in their returns to parliament they called double bottom cases merely single cases, and yet they charged the case-maker 1*s.* 9*d.* for stamping them, as two cases, whereas the law only allowed them to charge 10*d.* per case, and he believed the word "case" in the act of parliament meant a complete case, and not half a one. They ought to have had from the company a complete and business like answer, but instead of doing so they evaded it by urging the income and expenditure of the assay office. It might be carried on in too expensive a system, and perhaps the salaries paid were too high, but a manufacturer had certainly a right to complain when a charge was made which was considerably more than the rate of workmen's wages warranted. As to the statement that a reduction in the charges would not afford much relief to the trade in general, they were not asking for relief, but for what they considered their rights. The company had not met them at all with reference to the silver trade, but they ought to have done so. It was suggested that the company would reduce the charge 6*d.*, but they wanted them to abide by the law, and charge 10*d.* for what they now charge 1*s.* 9*d.*, or even to reduce it lower than that, in consideration of the number stamped in the course of the year. With regard to the statement of the company that the large case-makers would not approve of a change in the mark used, the case-makers only made the cases up to a certain condition, and it was no part of a case-maker's duty to see it in a finished state, therefore the case-maker's opinion was of no material value. That was another proof that the wardens of the company were unable to form a judgment on this matter, for if they had known anything about the business of watch manufacturing they would not have referred them to the opinion of watch case-makers. The company talked about the value of their mark when it reached a foreign country, and it was evident they did not know what they were talking about, for they had nothing on which they could form an opinion. The traders surely were the best judges on this matter, and often in polishing a case the mark was so obliterated that it was impossible to say what mark it was. There was no doubt the wardens asked the opinion of their assayers and stampers on the subject, and it was not to be supposed they wished for a change, but that was only an opinion. They were, therefore, justified in saying they were not satisfied with the answer they had received in that respect. The deputation had at least accomplished a great good for the trade, for the company acknowledged their present system was open to improvement, and by that means removed a mountain which the case-makers had never attempted to climb. This concession, however, did not go far enough. With reference to the mark itself, the deputation told the wardens, that in polishing the case the tool caught it and almost obliterated it, and they were constantly being asked how they were to know the difference between an electro-plated article and a silver one, because they were both stamped at the back. It was true there was a law affecting the stamping of plated articles, and it was quite right it should be so; but he thought they were now reaching a time when individuals would have sufficient confidence in each other that their names would be sufficient. If the articles were to be stamped, however, the manufacturers had a right to demand that it should be done without damage to the work or ornaments on it.

Mr. GLASGOW seconded the motion. He was sorry a larger number of case-makers had not come forward in support of this movement, but he supposed as soon as they succeeded in getting it altered there would not be a case-maker in Clerkenwell who would say he was satisfied with the present state of things. It was impossible they could be, but the truth was they were carrying favour with the Goldsmiths' Company, which was a disgrace to them. The case-makers would not come forward to assist them until they got redress, and then it would be suddenly found out what a great thing had been done, and they would all come on their side. It was not only a question of competition with the Swiss manufacturers, but the American war would not last for ever, and when it was over they would have them also to compete with. The

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English were losing their trade now rapidly, and unless the present system were altered, they would lose it still more. The wardens told the deputation the stamp was a work of art, but if they were to put it on sufficiently light to stamp a thin case it would all polish out, and if it was put on heavily it would go through almost all Swiss cases. If they kept the matter before the company, and let them see they meant to have redress somehow or somewhere, they would get a complete and straightforward answer to their complaints before long.

Mr. HOLLIDAY would ask some of the case-makers present to favour the meeting with their opinion on this matter, so that it might be a full and free discussion. There could be no doubt the case-makers had to lose time in putting these cases in proper order when they came back from Goldsmiths' Hall, and if he could get his work done without having a man a day or two doing nothing else but repairing the damage they had done, it must be considerably better for him, and this was one of their great complaints. With regard to the scraping they did hold out some hope that it might be altered.

Mr. BAMFORD did not see that any improvement could be made in the present system of stamping the cases. As to the remarks that a case-maker had not to finish a case that was true, but they had to leave their work smooth. It was entirely different with Swiss watches. The machinery used in the manufacture of the cases was widely different, and he was quite in favour of the cupel in preference to the touchstone. As the case was unfinished, the stamping did not injure it, as it merely raised it where the stamp was, but that could be easily polished down. It was true the scraping was injurious, but he had sufficient faith in the Goldsmiths' Company to think they would use cases according to the thickness of them. If they were to see cases when they were returned from the Goldsmiths' Hall, he was convinced they would change their opinion as to the injury they received, and he thought the company could not be censured for the way in which they did their work, and being stamped on a flat surface, it was done smoothly, and in no way interfered with the finishing of the work. The reason why they could not compete with the Swiss was because they had not the machinery, for one thing, and another was because English cases were generally preferred for their solidity, whereas Swiss cases give satisfaction to neither the wearer nor manufacturer, as they were much too thin.

Mr. HARVEY thought the Goldsmiths' Company had offered to remedy the scraping, and therefore it could not be said an answer was not given to that part of their complaint. He had known case-makers complain, and there could be no doubt they were very seriously hindered by the carelessness of the stampers sometimes, but bad workmen were always a nuisance wherever they might be, and he thought it was more their fault than that of the stamp, and it was the exception, not the rule. Case-makers were certainly most interested in the matter, and they did not think it could be altered, besides, as the company said, the mark was known all over the world.

Mr. TILLING said there was a great want in their being unable to compete with the Swiss; but as to Mr. Bamford's remarks that they had not machinery equal to the Swiss, that would be easily remedied, he thought, for they had the finest machinery in the world in this country.

Mr. SWINDLE said he had spent his life in polishing cases, and had no cause to complain of the way in which the work was done at the Goldsmiths' Hall. It was true he did not have the cases directly they came from the Hall, but when they were sent to him by the case-makers he never found them injured. They were possibly much thinner were the stamp was, and he thought an outline mark would be much better than the present stamp.

Mr. LAWRENCE did not think they could get a man to make a case as light as the Swiss, but as to the scraping, that might be much improved. As to the charge for stamping, that was a thing that affected the case-makers, and he believed if the Goldsmiths' Company took off sixpence, the manufacturers would want a shilling taken off, and therefore the case-makers, instead of gaining would lose by it. He believed if the Goldsmiths' Company had taken the matter into serious consideration, the case-makers would have called a meeting to oppose them thick and thin.

Mr. WENBORN had great difficulty in his work, in consequence of the way in which it was treated by the Goldsmiths' Company. He had seen the Hall mark nearly polished out very often, but it would be very difficult to injure a skeleton mark. With respect to the remarks of Mr. Jones, that the company charged 1*s.* 9*d.*, whereas they were only entitled to 10*d.* per case, he would send that amount, and if they demanded more he would refer them to Mr. Jones for an explanation. If he could get his work stamped lightly, and not so much damage done to the case, he could afford to submit to a reduction in the price.

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Mr. Jones said there seemed to be an opposition on the part of the case-makers, mainly through fear of having to reduce their price, if the company reduced theirs. The case-makers, however, should bear in mind that more pressure could not possibly be put upon them than the market allowed. There was no denying the fact that men were leaving the watch trade by dozens, and it was solely caused by the high price of the cases in this country. The consequence was the trade was falling off in London. The returns of the Goldsmiths' Hall would show a great defect in the number of cases stamped, if they were not enabled by an Act of Parliament to put the London stamp on Coventry cases. They had almost entirely lost the ladies' watch trade, simply because they could not make the cases thin enough. In three cases out of four if a lady went into his shop she wanted a cheap watch, and if he were to tell her he liked heavy cases, and did not keep light ones, she would say she was very sorry, but she had come to the wrong shop. She would then go to the opposite side of the way to a Swiss watch maker, and he would supply her with the articles which she wanted, and laugh at the English makers. They surely had as much and more right to a ladies' watch trade than foreigners, but London case-makers were not prepared to supply them with sufficiently light cases, and the inference to be drawn from that was, that London case-makers were unable to assist them in recovering the trade. If they had not the machinery to do it, it was their own fault. It was a curious coincidence that the company should state that they had reason to believe the larger case-makers would not approve of a change, and that when the deputation waited on the company, several large case-makers were seen coming out of the Hall. There was one thing he could tell them, and they must bear in mind that the manufacturers had the power in their own hands, that if the case-makers were so obstinate, and refused to come forward and assist in this matter, he would send his movements over to Switzerland and have the cases put on there, and others would do the same, as the name of the firm would be sufficient to sell the watch. An English case was nothing to him in a foreign market, but if he put his name on a watch it would sell with or without a Hall mark. If the London case-makers did not known how to make sufficiently light cases, there were plenty of Swiss ready to come over and teach them; but make cases of sufficient lightness to meet the demand they must, or the manufacturer would have to get them elsewhere, and the inevitable result of that would be that the English case-makers would lose their trade.

Mr. J. Harvey moved as an amendment, "That, in the opinion of this meeting, the answer received from the Goldsmiths' Company be received as satisfactory in respect to their future promise of care in stamping and scraping."

Mr. Laurance seconded the amendment, which was put and lost.

Mr. Wenborn moved as an amendment, "That this meeting is of opinion that the reply of the Goldsmiths' Hall to the complaints ordered to be submitted to them is scarcely satisfactory, and that a more careful scraping of the case, with the substitution of a skeleton mark for the present one is highly desirable, and trust that the alterations admitted to be necessary may be promptly carried out, and that the manufacturers of watches who have to trade in competition with the Swiss in all parts of the world are better judges of what will promote their trade than the wardens of the Goldsmiths' Company, who have no connection with the trade."

Mr. J. Oliver seconded the amendment, which was also lost, and the original motion carried.

Mr. Mylne moved, "That the Council of the Institute, with power to add to their number, be authorized to submit the matter of assaying, stamping, and charging watch cases to the Board of Trade, with a view of obtaining redress."

Mr. Straiton seconded the motion, which was put and carried, and

A vote of thanks to the Chairman closed the proceedings.

British Horological Institute.

PRIZE FUND.

EXTENSION OF TIME.

DETACHED LEVER ESCAPEMENT.

At a Meeting of Subscribers to the Prize Fund, held on the 22d March, at the Institute, it was resolved as follows:—that in consequence of the Essays sent in by the 3rd of March, being professedly in an incomplete state, and as the competitors desired longer time, it is decided that the time be extended to the 29th of September next, for further open competition, and that the period now fixed for delivery of Essays be absolutely final. The portions of Essays already received will therefore remain unopened till the above date.

John Jones, *Chairman of Com. of Prize Fund.*
R. Strachan, *Honorary Sec. to the Committee.*

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., February, 1865.

11, *Offord Road, N.*

Days of the Month.	Barom. reduced to 32° F. and the sea level.	Temperature in the Shade. At 9 a.m.	Highest in the previous 24 hours.	Lowest during the previous 24 hours.	Rainfall.	Wind. Direction.	Force (scale 0–12)	Weather. At 9 a.m.	During the next 24 hours.
	Inches.	o	o	o	Inch				
1	28·895	40	44	37	0·30	WSW	2	m	om
2	29·115	46	48	38	—	WSW	6	c	r
3	·175	43	50	39	0·16	S	3	m	om
4	·536	38	45	36	—	E	3	om	o, r
5	·758	34	38	32	0·02	S	1	o	o, r
6	·971	38	38	34	0·13	SW	1	m	omr
7	·849	45	45	36	0·07	WSW	5	om	r, m
8	·893	38·7	50	37·5	0·13	N	2	m	c, b
9	30·274	33	39	30	—	NE	4	b	b
10	·590	33	38	29	—	NE	2	om	bc, s
11	·577	28·5	36	25	0·05	SE	2	m	m, b
12	·383	28·5	29	25	—	NNE	2	b	bc, s
13	·241	27	34	25	0·11	ESE	3	s	s, m
14	·255	30·5	32	25	0 02	NE	3	o	o, b
15	·078	22	32	18	—	NE	1	m	f, o
16	29·528	31·5	31·5	20	—	W	1	o	s, r, s
17	·355	31·5	39	28	0·38	W	4	b	r, bc
18	·655	35·5	38	30	0·05	W	3	cb	r, q
19	·333	37	46	33	0·07	W	9	b	bcs
20	30·044	31	41	28	0·03	NW	7	b	bc
21	·437	31·5	36	27	—	W	5	o	s, o
22	·313	36	36	30	0·11	WSW	2	m	omr
23	·349	44	44	35	0·05	W	4	bc	oc
24	29·757	46	50	42	0·10	SW	7	rq	r, o
25	30·162	39	46	35	0·40	NW	2	b	bc, o
26	29·995	42·5	46	37	0·04	SW	4	r	r
27	30·201	40·3	46	36	0·16	NE	1	c	c, r
28	29·565	48	48	39	0 03	SW	4	o	bc, or
	29·903	36·4	40·9	31·7	2·41	s81w	1·5	—	Means.

17th, 9 to 10 p.m., aurora was seen at Nottingham, 19th, 9 a.m., at Liverpool, the the pressure of the wind was 29 lbs. on the square foot. A severe gale the whole of this day.

Jottings: Rain. The principle upon which the rainfall (including snow or hail when melted) is estimated is very simple. A receiver is placed in an open space, and the depth of water which falls into it is carefully measured. Then assuming that the rain has fallen to an equal depth upon the surrounding district, the quantity deposited upon a definite area, as an acre, can be computed from the indication of the gauge. A depth of one inch of rain on an acre yields 6,272,640 cubic inches of water; which, at 277·3 cubic inches to the gallon, and 224 gallons to the ton,—weighs nearly 101 tons. Hence for every hundredth of an inch, about one ton of water falls per acre.

The instrument destined to give the depth of rain which has fallen, should expose a space at least eight inches in diameter for the reception of the downfall. The rain-gauge should be placed in an open space, at a distance from walls, buildings, or trees, at least equal to their height, but not too much exposed to the wind.

Fog. "Given a broad river, with a temperature at the time above that of the air; let there be another vast moisture exhaling surface on its banks 60 or more square miles in extent, and this area covered with houses which pour smoke from a million chimneys into a still atmosphere, and the result is that almost impervious fuliginous mass called a London Fog."—*From the Registrar General's Report.*

EQUATION OF TIME TABLE

For April, 1865.

Day of the Week.	Day of Mth.	At Apparent Noon. Equation of Time to be *added* to *subtracted* from Apparent Time.	Difference for One Hour.	At Mean Noon. Equation of Time to be *subtracted* from *added* to Mean Time.
		m. s.	s.	m. s.
Sat....	1	3 53·96	0·755	3 54·01
Sun ...	2	3 35·89	0·751	3 35·93
Mon ..	3	3 17·93	0·746	3 17·97
Tues...	4	3 0·10	0·740	3 0·14
Wed ..	5	2 42·42	0·733	2 42·45
Thurs .	6	2 24·91	0·726	2 24·94
Fri....	7	2 7·59	0·718	2 7·62
Sat....	8	1 50·48	0·708	1 50·51
Sun ...	9	1 33·61	0·698	1 33·63
Mon ..	10	1 16·99	0·687	1 17·01
Tues...	11	1 0·65	0·675	1 0·67
Wed ..	12	0 44·61	0·662	0 44·62
Thurs .	13	0 28·88	0·649	0 28·89
Fri....	14	0 13·48	0·635	0 13·48
Sat....	15	0 1·57	0·620	0 1·57
Sun ...	16	0 16·25	0·604	0 16·25
Mon ..	17	0 30·54	0·587	0 30·54
Tues...	18	0 44·41	0·570	0 44·42
Wed ..	19	0 57·87	0·552	0 57·88
Thurs .	20	1 10·91	0·534	1 10·92
Fri....	21	1 23·49	0·515	1 23·50
Sat....	22	1 35·62	0·496	1 35·63
Sun ...	23	1 47·28	0·476	1 47·30
Mon ..	24	1 58·46	0·456	1 58·48
Tues...	25	2 9·16	0·436	2 9·18
Wed ..	26	2 19·38	0·415	2 19·40
Thurs .	27	2 29·09	0·394	2 29·11
Fri....	28	2 38·30	0·373	2 38·32
Sat....	29	2 47·02	0·352	2 47·04
Sun ...	30	2 55·22	0·331	2 55·24

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LECTURE ON THE GREENWICH SYSTEM OF TIME SIGNALS.

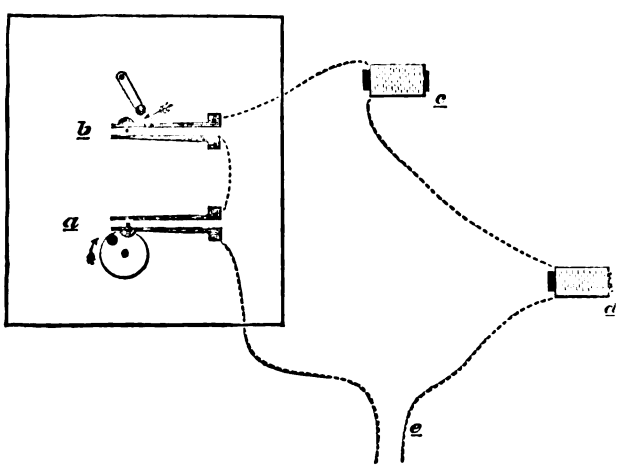
By WILLIAM ELLIS, Esq., F.R.A.S., of the Royal Observatory, Greenwich.

(*Continued from page* 91.)

Having described the system of mean time clocks within the Royal Observatory and the manner of keeping them constantly adjusted to exact time, we now proceed to consider the means used for giving time to the public and distributing time throughout the country. Every thing originates with the normal mean time clock, and one of its most important duties is the giving of hourly time signals. As concerns the exhibition of time to the public we may here refer to the clock (sympathetic with the normal clock) placed in the external wall of the Observatory, which however, having been already spoken of, requires only this passing allusion. For the distribution of hourly time signals there passes through the face of the normal clock, a circuit, in which two breaks exist, at each of which there is placed in circuit a slender pair of insulated springs, as shown in the annexed diagram. Contact of one pair of these springs (the lower pair) is made complete from about half a minute before to half a minute after each hour by a pin set on a disc fixed to the minute hand pipe, contact of the other pair being completed at the 60 seconds exactly by a pin set on an arm fixed to the seconds' hand spindle. No current can pass unless the contact of both pairs of springs is complete *at the same time*, and from the description given it will be seen that this can take place only at the 0' commencing each hour. The current, thus created by the normal clock at each hour, passes away to the coils of two electro-magnets, the ball magnet and the hourly relay magnet, the particular use of each of which is the next thing to be considered.

The ball magnet is made use of only once daily (at 1^{h} P.M.) to discharge the time ball fixed over the eastern turret of the Observatory, although, as all the hourly currents pass through the coils of this magnet, the ball could be dropped at any other hour also, if it were thought necessary so to do. This ball was erected and commenced to be dropped in the year 1833, but it is only since 1852 that its discharge has been effected by galvanic current. The mast on which the ball slides may be described as being square and having a groove on one side, the hole through the ball fitting the mast exactly. Under the ball there moves in the groove, a sliding piece, the upper end of which rests against the ball, whilst the lower end is fixed to an iron rod terminating below in a piston, *a* in the annexed diagram. The rod is raised by means of a winch and chain; the chain passes up over a pulley and is brought down to a collar which encircles the rod and which itself moves on guide rods. The collar in rising acts against a shoulder on the rod and pulls up the rod and sliding piece attached

Fig. 5.—Normal Clock Hourly Signal Circuit.



a, contact made complete from 59½^{m} to 60½^{m}.
b, contact made complete at 60^{s}.
c, Ball magnet.
d, Hourly relay magnet.
e, Battery wires.

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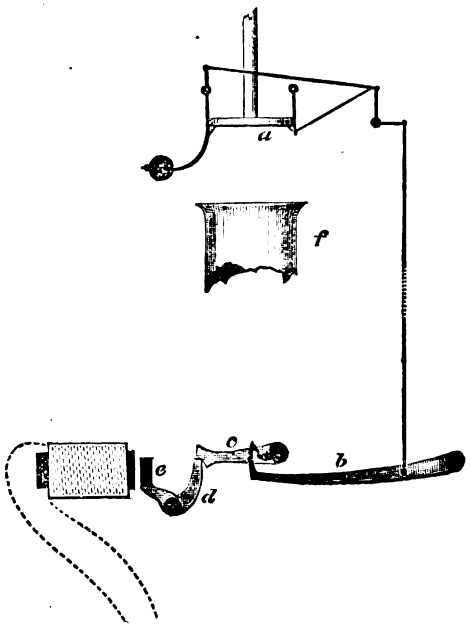
above, the sliding piece pushing the ball up the mast. When raised to the proper height, the piston becomes lodged between two clipping pieces, as shown in the diagram, the clipping pieces having a spring motion to allow the piston to rise up between them. The piston being thus supported, the chain is unwound and the collar slides down the rod, leaving it free to fall when the piston is discharged.

Fig. 6.—Greenwich Time Ball.



(The Electro-magnet in this diagram is the same as that shown at *c* in Fig. 5.)

The two clipping pieces by means of intermediate levers are connected to the lever *c*, which is held in position by the arm *d*, carried by the spindle of the ball magnet armature *e*. When the current at 1^{h} animates the ball magnet, the armature *e* is attracted, carrying with it the short arm *d*; the levers *c* and *b* fall, communicating motion to the clipping pieces which open outwards and allow the piston and the rod, with the ball above, also to fall. The fall is at first very rapid until the piston enters the open topped iron cylinder *f*. The air in the cylinder has no means of escape except by an orifice at the foot of the cylinder, and thus becomes compressed by the piston; the rapidity of fall is thus very soon checked and the ball comes gently to rest at the foot of the mast. The pull of the armature *e* produces of course no effect except at 1^{h}. It will be seen that by the interposition of the lever *c* the pressure on the end of the arm *d* is very much reduced, so that the discharge takes place more easily. To take time from the fall of the ball, an observer should note the instant of separation of the ball from the cross placed immediately above, which is very sudden.

The Greenwich time ball was the first erected; in those established since, improvements have been introduced; for instance, the mast on which the ball slides is now made double, so that the ball rod comes up between the two parts of the mast; instead also of using a pulley and chain &c., for raising the ball, the rod carries a rack into which a pinion works: after the ball is raised, it is then necessary only to put the pinion out of gear with the rack, in place of the unwinding process in the Greenwich ball.

The hourly relay magnet plays a most important part in the daily distribution of time signals throughout the kingdom. The pull of its armature, by the clock current at each hour, completes the contact of various pairs of insulated springs: in each pair, one spring is in communication with a battery and the other in connexion with a wire passing to some station beyond the Observatory walls: three pairs of such springs are at present in use; each hourly clock current thus creates three new and independent currents, which speed from the Observatory along separate wires each to its special destination.

Now of the three wires conveying hourly time signals from the Observatory, one communicates with the principal London office of the Electric and International Telegraph Company, from which point the signals are distributed very extensively both in London and throughout the country; another communicates with the London Bridge Station of the South Eastern Railway Company, from which point distribution of the signals is made principally in London and to stations on the South Eastern systems of railway, the current at 1^{h} P.M. being used to drop a

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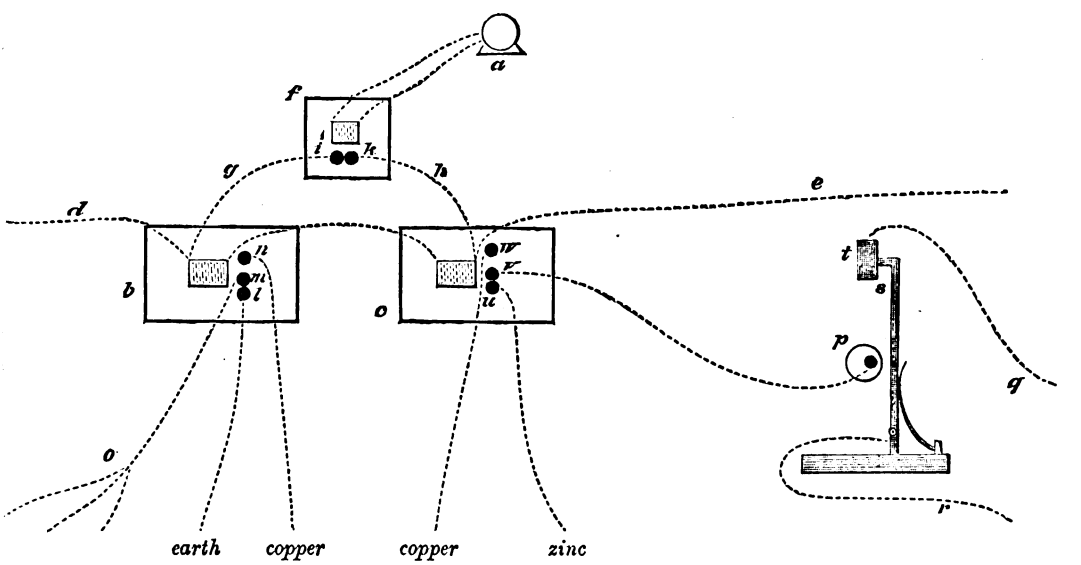
time ball belonging to the Admiralty erected at Deal; the remaining wire communicates with the central London office of the London District Telegraph Company, who also make some distribution of signals in London. The last mentioned wire does not pass along the South Eastern Railway, as do the other wires, but runs along the London District Telegraph Company's own poles, from Greenwich through Deptford and on to London. The duty of the Observatory, speaking generally, ends with the due transmission of the signals from the Observatory; their further circulation depends on other parties, the time signal system being indeed one which owes its entire success to a system of mutual co-operation.

The distribution of signals by the Electric and International Telegraph Company is effected in their offices in Telegraph Street, Moorgate Street, by automatic apparatus, designed by and constructed under the superintendence of Mr. C. F. Varley, Electrician to the Electric and International Telegraph Company, who has greatly extended the system originated in the first instance by Mr. Edwin Clark, and Mr. Latimer Clark. Mr. Varley's new apparatus is in all respects most admirable and efficient: its office is to transmit (extensively and in many directions) the currents received from Greenwich. Mr. Varley calls it the "Chronopher," of the principal parts of which the following is a description. In the Telegraph Office there is a clock (*a* in the annexed diagram) which by means of

Fig. 7.—Mr. C. F. Varley's Chronopher.



(For clearness some details have been here omitted, as also have those parts specially added for the purpose of firing the Tyne time guns.)

the signals received from Greenwich is kept adjusted to Greenwich time. In circuit with the Greenwich wire *d*, two relays *b* and *c* are placed, and every hourly current from Greenwich passes through these relays; *b* is known as the London relay, and *c* as the Provincial relay. In the ordinary state of the apparatus, the relays are on what is called "short circuit;" any current arriving on the Greenwich wire has two courses open, it can pass from *d* to *e* either through the long wire coils of the relays, or by the wires *g* and *h* through the switch *f*, but whilst both courses are together open, it will take the shorter route through the switch: a small portion of the current will indeed pass through the coils, but its amount will, on account of the great length of wire in the coils as compared with the length of the wires *g*, *h*, be

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so minute, as practically not to require consideration. Now, from a very few seconds before to a very few seconds after each hour, the clock *a* by action on an electro-magnet in the switch, breaks the contact of *i* and *k*, and during such times any current arriving on the Greenwich wire *d* must, to get to *e*, the continuation of the Greenwich wire, pass through the coils of *b* and *c*, the shorter route by *g* and *h* being no longer available. As the contact of *i* and *k* thus remains broken for a very short time, the chance of interruption by any accidental or stray current in the Greenwich wire is thereby reduced to a minimum. The passage of the Greenwich current through the London relay causes the contact of *l* and *m* to be broken, and *m* to be thrown into contact with *n*: *n* being in connexion with the copper pole of a battery, a current immediately passes from *n* to *m* and distributes itself on the branches *o* to different points in London, and this distribution takes place every hour. The stop *l* being in connexion with "earth" it follows that so long as *m* remains in contact with *l*, any stray current which may happen to come up on any one of the branches *o* will pass to earth: without such connexion it would pass out again on the other branches. The passage of the Greenwich current through the provincial relay similarly causes a current from the copper pole of another battery to pass to a wire from which branches proceed to many provincial telegraphic lines, but although the relay is acted on by the Greenwich current at every hour, the action is effective only at 10^{h} A.M., as it is at this hour only that the provincial lines are placed in connexion. Now as for this distribution wires employed in the ordinary telegraphic business are made use of, and as these wires are in their usual state each in connexion with its own speaking instrument, it follows, that before the action of the provincial relay can be effective, they must all be switched from their respective speaking instruments to the relay. This is done by a commutator in the following manner. The clock *a*, at 9^{h} 58^{m} every morning, starts a piece of clock work, which sets in motion the eccentric barrel *p*. This makes one revolution in four minutes, and consequently at 10^{h} 0^{m} will have turned half round. Now *q* represents a wire coming from a speaking instrument, and *r* a wire passing to the provinces, and as long as *s* and *t* remain in connexion, the ordinary telegraphic work can proceed without interruption. But at 10^{h} 0^{m} the eccentric barrel having turned half round will have pushed the spring *s* out of connexion with the stop *t*, by which the ordinary telegraphic circuit is broken, the spring *s* remaining in contact with *p*. In the same way for each of a number of provincial wires, the circuit is similarly broken by the barrel *p*: the springs corresponding to *s* are all thrown out of connexion with their respective stops and remain lying side by side along the length of the barrel. In this state then, the action of the provincial relay becomes effective, for on the passage of the Greenwich current, the contact of *u* and *v* being broken, and *v* being thrown into contact with *w* a current from the battery in connexion with *w* passes by *v* to *p*, and the springs (of which *s* represents one) being all in contact with *p*, the current divides and distributes itself on all the provincial lines in connexion. The signal passes as far as Brighton in the south, Lowestoft in the east, Cardiff in the west, and Glasgow in the north, as well as to Manchester, Birmingham, Liverpool, and other important places. The barrel continuously turning, stops at 10^{h} 2$_{m}$, in the position from which it first started, before which time *p* will have turned out of connexion with *s*, leaving *s* again resting on *t*, restoring again the ordinary telegraphic circuit. And similarly will all the circuits interrupted by *p* be restored. In this state all as respects the great provincial distribution will remain until 9^{h} 58^{m} of the following morning. It will be remarked in the diagram, that *u* is in connexion with the zinc pole of a battery (one distinct from the others spoken of). As soon therefore as, immediately before 10^{h}, the provincial wires are brought into connexion with *p*, each station receives a constant zinc current by which it is known that connexion with the provincial relay has been established in London: this answers as a warning signal, the true time signal corresponding to the instantaneous

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reversal of the current from a zinc current to a copper current.

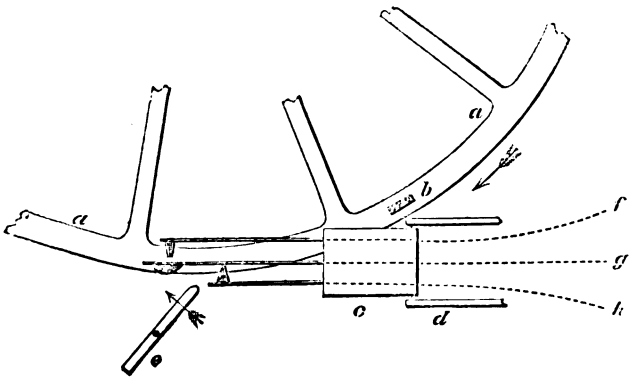
In addition to what has been described above, the clock *a* also breaks the Newcastle telegraphic circuit for a short time at 1h, and places the Newcastle wire in connexion with the provincial relay, in order that the Greenwich 1h current, by action on the relay may cause a current to pass on to Newcastle. At Newcastle a clock kept adjusted to Greenwich time makes automatically the proper connexions for allowing the current arriving at Newcastle to act on relays which transmit currents to discharge the Tyne time guns, one of which is placed on the old Norman keep at Newcastle, the other at North Shields. The arrangements for discharge of these guns have been only thus briefly indicated, they being similar in principle to those already described at length. The actual discharge of the guns is effected by means of a fuze, invented by Mr. F. A. Abel, of Woolwich Arsenal, which explodes on the passage through it of a galvanic current, and is very effective. The galvanic current passes through a composition in the fuze, which being ignited, explodes the gunpowder in contact with it. The gun at Newcastle is a 12-pounder gun, that at North Shields is a 24-pounder. Very general reference appears to be made to these guns, not only by the public generally, but (as Mr. James Mather of South Shields informs me) also by manufacturers and shipbuilding companies, &c., for regulation of their works; and not less important are the facilities they give for the rating of chronometers, &c.

Time signals have been distributed by the Electric and International Telegraph Company since the year 1852, but the Newcastle and Shields guns were established only in the year 1863.

The hourly signals communicated from the Royal Observatory to the South Eastern Railway Company are all placed at the disposal of Mr. Walker, who has extensively distributed them since the year 1852. From this is to be excepted the signal at 1h P.M., which is by agreement reserved for the service of the Observatory, being used to discharge daily at that hour the time ball at Deal, already alluded to. For this purpose the South Eastern Railway Company liberally place the necessary wire communication at the service of the Observatory, for a short time at 1h daily, as a return for which time signals are transmitted to them at other hours for their own benefit, as above mentioned.

A large clock placed in the Telegraph Office at London Bridge is used for switching to the Greenwich wire, the Deal wire at 1h, and at other hours such of the South Eastern or other wires as Mr. Walker may desire to place in connexion. This clock is a galvanic clock, but is controlled (as will be afterwards described) by independent galvanic currents given from Greenwich, for which purpose there is an additional wire. The clock possesses a large wheel revolving once in 24 hours, a portion of which *a a*, is shown in the accompanying diagram. On this, certain projections are fixed, corresponding to hours at each of which some one wire is to be connected to the Greenwich wire. One of these is shown at *b*. A frame *c*, moving on an upright axis at *d*, carries various sets of springs, three in each set. One set is shown in the

Fig. 8.—Contacts in London Bridge Switch Clock.



f, wire from Greenwich.
g, wire in connexion with a distant station.
h, wire in connexion with earth at London.

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diagram. The two lower springs in each set are ordinarily in contact, forming indeed each a portion of a telegraphic circuit; the upper spring in each set is in connexion with the Greenwich wire. When a signal is to be passed, one of the projections on the 24 hour wheel pushes aside the frame *c*, bringing thereby one of the sets of springs into a position such that the point of the arm *e*, revolving once in an hour, lifts the middle spring away from the lower spring, and into contact with the upper spring. After the signal from Greenwich has passed, the arm *e* moving on, allows the middle spring to fall again to the lower spring, and so restore the ordinary telegraphic circuit. At some other hour another projection on the great wheel will push aside the frame *c*, so as to bring a different set of springs over the arm *e*, and so the distribution goes on. It is by means of this clock that communication is established by which the signals at 2^h P.M. and 8^h P.M. are transmitted to the British Horological Institute.

It has been mentioned that the signal at 1^h is used to drop the Deal time ball. But the wire connected with the Greenwich wire at 1^h by the London Bridge clock does not pass directly to Deal. At the Ashford junction station, a considerable distance down the line, another connexion has in consequence to be made. To effect this, a clock is there placed, which changes the ordinary telegraphic communication just at 1^h, connecting the London branch of the wire to a wire passing to Deal. At Deal there is a loop wire to the ball tower. After the ball has been raised, the ball lever has to be put full up ready for discharge. This acts upon and locks a switch apparatus, which makes the last change in the communication, breaking the ordinary circuit, and placing the apparatus in the ball tower in communication with Greenwich. When the Greenwich current passes, it animates at Deal a small relay, which closes a local circuit, the current in which, acting by an electro-magnet, discharges the ball, in the same way as the clock current at Greenwich discharges the Greenwich ball.

(To be continued.)

JOTTINGS.

The third anniversary dinner of the Edinburgh Horological Society took place on the 8th April; and we rejoice to hear that the Society is in a flourishing condition.

"The chronometer-makers of France are occupied in preparing various instruments for the Paris Observatory and others for the King of Italy. A large quantity of clocks and watches are likewise being manufactured for export to Mexico."—*Times, 11th April.*

Commander Arthur, R.N., has invented a compass for registering a ship's course at sea on prepared paper, working on a cylinder by clockwork, the direction of the ship's head being marked by an indicator pencil every two minutes and a half.

BRAZILIAN BEETLES.—The jewellers are now setting Brazilian beetles in gold or silver, to form bracelets, necklets, brooches, &c. The beetles chiefly used are found in immense numbers at Bahia, and are brought to England in the Brazilian mail packets. They are of small size, and their colours are green and gold. They are caught in nets to prevent their mutilation, and are sold at about 1*s.* each in this country.

BOILING CLOCKS.—A correspondent of the *Scientific American* says that common brass clocks may be cleaned by immersing the works in boiling water. "Rough as this treatment may appear," he says, "it works well; and I have for many years past boiled my clocks whenever they stopped from accumulation of dust or a thickening of oil upon the pivots. They should be boiled in pure or rain water, and dried on a warm stove, or near the fire."

This is the first time that we have heard of boiling clocks and doubtless the experiment may be matched with that of boiling aneroids, with equally successful results. We have heard of a gentleman who purchased an aneroid marked "compensated for temperature," and hit upon the novel expedient of testing its compensation, by boiling it in a saucepan. Of course the boiling water loosened the solders, spoiled the chain and springs and completely did for it.

OBITUARY.—We announce with deep regret the death of Frederick William Knight, the eminent Engraver, on the 18th day of March, 1865, aged 55 years. He was an earnest supporter of the Institute, a valuable member of the Council, and was most highly esteemed and respected by all who knew him.

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BRITISH HOROLOGICAL INSTITUTE.

THE ANNUAL DINNER.

The annual dinner of the members and friends of the British Horological Institute, took place on the 7th April, at the Freemasons' Tavern, Great Queen Street. The Right Honorable the Earl of Caithness occupied the chair, supported by Valentine Knight, Esq., President of the Institute, and E. D. Johnson, Esq., F.R.A.S., Vice-president. The vice-chairs were occupied by Messrs J. Jones and Klaftenberger. Among nearly 100 influential members of the trade present we noticed Messrs Knight, jun., Brocot, E. J. Thompson, J. Jackson, J. Bennett, J. Hutton, Crisp, Glasgow, Lange, Storer, Mylne, Tilling, Holliday, Holdsworth, Dempster, &c.; among the visitors who honored the Institute with their presence were, Dennis Mc Donnell, Esq., W. J. Wilson, Esq., Mc'Cullagh Torrens, Esq., &c.

The cloth having been removed,

The NOBLE CHAIRMAN proposed in succession, in neat and appropriate speeches, "The Queen," "The Prince and Princess of Wales, and the rest of the Royal Family," which were drank in a loyal and enthusiastic manner.

To "The Navy, Army, and Volunteers," Mr. John Bennett, on behalf of the volunteers, responded in a highly humorous speech.

The CHAIRMAN said he rose with great diffidence to propose the next toast, as the present was the first time he had had the honor of presiding at any philosophical society in London, but it gave him the greatest pleasure that it was at the Horological Institute. The object of this society was to improve and carry out the measuring of time to its greatest possible extent. It might be asked, "What is time?" It was a perceived number of secret movements; and that he believed gave one as good an idea of time as anything one could explain it by. One of the most important aids—until watches and chronometers were invented—as to the measurement of time was discovered by Galileo, when a student at Pisa, in 1581. Galileo was sitting in a cathedral and observed that the chandelier moved or oscillated from one side to another, being no doubt driven by the draught through the church. This Galileo, being a man of science and a clever man, turned to practical account, and he thought it was about the early part of the seventeenth century that he applied this to the measurement of time. The use of this could not be too highly appreciated, for they all knew the value of the pendulum. The origin of clock-work was involved in great mystery, very little was known of its earliest promoters. He had heard that an archdeacon of Verona, named Pacificus, invented some clockwork and set it in motion as early as the ninth century. No one had a word to say against the use of a clock; the value of a clock everybody knew. A clock was a machine which had involved a large amount of labour to the brain, and had now become a beautiful instrument. It was looked upon with much care and attention by all. This was particularly the case in Scotland. A Scotchwoman would say of a night to her husband, "Hae yé row'd up the nock?" meaning, "Have you wound up the clock?" And if the same old lady was asked the time, she would say, if that was the hour of the day, "Oh, it's jist chappin twelve," meaning, "It is just twelve o'clock." But she thought nothing about who made the clock, or regulated the measurement of time; so long as the clock was wound up and would indicate the time she was satisfied. He was sorry to find that the manufacture of clocks was going very much out of England, and he would urge the members of the Horological Institute to put their shoulders to the wheel, and to try to bring back the manufacture of clocks to this country. He did not see why skilful artisans in England should not be able to compete with America, France, or any other country on the face of the earth, and thus keep clock-manufacture in our own country. But he believed we had not the machinery in this country which would stamp out all the wheels of a clock, as the Americans had. After remarking that he saw the other day a very beautiful clock, which had been the property of Mary Queen of Scots, the noble chairman said he would next refer to watches. What was a watch a few years ago? A watch was then what was now commonly denominated a turnip. Now those turnips, though they went uncommonly well, were very cumbersome and very large. But they had now arrived at great perfection in the manufacture of watches, which were now made small. The value of a watch was not confined to its worth and beauty as a piece of workmanship, for a watch was one of the most wonderful inventions of man—it was such a delightful, beautiful, and portable means of time-keeping. Time now a days was money, and half a minute was sometimes equal to a hundred thousand pounds. A good watch was one of the most important things a man could possess and no machine was more beautiful or more interesting than a watch. It was a singular fact that at the Exhibition of 1851 all the Swiss watches shewn were sold. There had been a large increase in the import duty on watches since the Exhibition of 1851. He believed that in 1852 there were 42,000 watches imported and duty paid on them; in 1853 there were 79,000; and in 1854, 100,000. Now, that came to be a very large number of watches paying duty, besides those that were smuggled, and a great many were smuggled. And he thought it was high time they took some steps to stimulate English workmanship, both in clocks and watches. About a million sterling had been sent abroad for the purchase of watches. Now what an amount of good would not that million have done in the improvement of the condition of the working people of this country? In 1855 there were made in England 187,000 watches, and the Swiss in the same time made 1,500,000. He would not vouch for the exact accuracy of the figures, but he had obtained them from good authority. He then referred to the chronometer, not only in relation to land work and its application to astronomical purposes, but also to its use

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in navigation. Without the chronometer what would navigation be? There was another very useful and interesting part of clock work, and that was the firing of time guns and the lowering of time-balls by electricity. That was done by clock work. He now came to a very important part of his subject, one well worth the while of all chronologists looking after, and that was the tools, which formed an important part in every manufacture. They would all remember that James Watt broke down in the most complicated part of his engine because he had not suitable tools. The tools were now, however, greatly improved, and were very beautiful. But he was sorry to say the Swiss tools were superior; and why should we not find out the means of tempering steel as well as the Swiss? The other day he was told in the French capital that they could temper steel better there than we can. Now, why should we not find out the best mode of tempering tools? In conclusion, he was extremely obliged to the Council of the Horological Institute for the honour they had done him in asking him to preside at the present meeting. He then proposed "Prosperity to the Horological Institute, long may it prosper, and may English watches excel all others." (The toast was drank amidst enthusiastic cheering.)

Mr. VALENTINE KNIGHT (President of the Institute) had much pleasure in responding to the toast which had been so eloquently proposed by the noble chairman, who had done them the honor to preside over them on that occasion. But he was not disposed to take so desponding a view of English clock and watchmaking as some gentlemen outside the trade might do. He had a long clock in his house which was made fifty years ago, and he was sure it would drive any American into fits to be asked to make anything like it. He had also a quarter clock which Americans could not touch in the way of imitation. The watches made in Switzerland were toys, and when ladies purchased them they very soon afterwards found they would be glad to get rid of them. A large number of the watches made in Switzerland were trumpery trash.

The CHAIRMAN explained that when he said clockmaking was going out of this country, he did not say that better clocks were coming into it.

(To be concluded next Month.)

Correspondence.

ASSAYING AND STAMPING WATCH-CASES.

To His Excellency the Right Honorable Earl Cowley, Ambassador of H. B. M. at Paris.

BRITISH HOROLOGICAL INSTITUTE,
28th Jan. 1865.

MY LORD,—I am directed by the Council of the British Horological Institute to ask your Lordship to do them the favor of enquiring what are the Regulations of the French Government regarding the stamping and assaying watch-cases manufactured in and imported into France. The Council have been informed that the test of value of the gold is ascertained by the touchstone and not by the cupel, and it is an important point for the manufacture of watches in this country to know the true facts. The Council refer to the districts of Besançon and French Switzerland, where the chief manufacture of watches is carried on, rather than to Paris. As early an answer as your Lordship can furnish will oblige. I have the honor to be, &c.

J. MOORE, *Secretary.*

To J. Moore, Esq., Secretary, British Horological Institute.

BRITISH EMBASSY, PARIS,
March 7, 1865.

SIR,—I regret that I could not reply sooner to your letter of the 28th January, but being unable to answer the question contained in it myself, I referred it to the legal adviser of the Embassy, and I now hasten to enclose his report upon the subject.

As I cannot charge M. Treite's expenses in this matter to the government account, I propose acquainting you with the amount as soon as I have ascertained it, and will then request you to have the goodness to reimburse me accordingly.

I have the honor to be, &c.
(Signed) COWLEY.

* *To his Excellency Lord Cowley, Ambassador of H B.M. at Paris.*

MY LORD,—Your Excellency has been good enough to ask me what are the customary regulations in France for the stamping or marking, and the assay of watch-cases manufactured in this country, as well as imported from abroad.

Your Excellency desires also to know very exactly, if the trial of the value of gold is made by the touchstone; lastly, you direct my attention less to the manufacture and the practice of Paris, than to the districts of Besançon, and of French Switzerland, where are found the principle manufactories of watches.

Upon this last point at once, I have the honor to reply that in the whole French Empire there is only one law, and that the

* Translated by the Editor.

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regulations which concern matters of gold and of silver are absolutely the same in the provinces, as at Paris. The law does not make any distinction between watches from abroad, whencesoever they may come, from Switzerland, from Italy, from Belgium, or from England; the regulations are identical for all. The treaty of commerce with Great Britain of 1860 has altered nothing *as to the stamp and the standard.* These are two questions, which in all civilized countries, affect the custom's tariffs less than the public security. Moreover this matter is everywhere the object of special laws, more or less severe according to the country. In Switzerland they are very rigorous.

I join to my letter the text of the law of the 19th Brumaire, year VI. (9th November, 1797), the general intentions of which quite as rigidly apply to watch-cases imported into France, as to all other articles of gold. The principles which it proclaims are always in force; it has suffered modifications only in the details of execution, in order to keep on a level with the progress of science. I sum up very succintly the intentions of the law, which refer more especially to *horological gold-ware*, for the manufacturers of watch-cases are assimilated to goldsmiths.

It is forbidden to employ any other standard than those indicated by the law, namely, *for gold*, the first standard 920 thousandths ($22\frac{2}{5}$ carats), the second 840 thousandths ($20\frac{4}{5}$ carats), and for the third standard 750 thousandths (18 carats). The last standard is the only one which is now used by the trade. *For silver*, the first standard is 950 thousandths, and the second 800 thousandths. *For gold*, there is a tolerance of three thousandths, and for silver of five thousandths. But in practice, this tolerance is easily extended, even up to 20 thousandths, especially when the article requires solders made with other metals.

The form of the punches or marks has varied already several times, and in order to prevent fraud it is susceptible of being again changed.

The works of gold or silver presented for importation are placed under seals at the Custom-house, and sent to the nearest guarantee office to undergo the trial required by the law.

In the guarantee offices they limit themselves to examining whether the articles thus imported are really in gold or silver. After this verification they are marked with the punch called *foreign, which neither indicates nor guarantees the standard.* It is intended thus to give to French works, *the value of which* IS *guaranteed by the stamp*, a superiority over the works from abroad, which being allowed to be fabricated of a lower standard, ought to inspire distrust even on account of the uncertainty of their standard.

As to watches coming from abroad, they are, by a royal ordonnance of the 7th April, 1838, marked with a special punch for imported watch-work *(horlogerie).* This foreign stamp is easily distinguished by every one. The same ordonnance has indicated those of the guarantee offices where the stamp should be applied, because the number and the situation of these offices have varied according to the necessities of commerce and industry.

In each guarantee office, there is an assayer, agent of the administration of the mint, and who is responsible for the standard which he declares. The assayer proceeds by cupellation, by the touchstone, as well as by the humid method for articles of silver.

The touchstone is the least certain of these operations, it is employed especially for the small works which cupellation would deteriorate too much; the instructions of the government permit this; but CUPELLATION IS THE RULE, for it is the only means of operating WITH CERTAINTY; *the touchstone is the exception*, although it is employed usually in practice. But if the last mode leaves the least doubt in the mind of the assayer, if as they say in technical terms, *the touch has not been free*, the assayer has recourse to cupellation.

Such is the ordinary mode of acting. But in order to respond to the desire of your Excellency to know if it is quite true that the watch-cases imported into France are assayed by the touchstone, I have wished to inform myself completely, and I have addressed myself to the chief of the guarantee of the Mint of Paris.

He replied as follows: "Legally there is no difference between the watch-cases fabricated in France and those coming from abroad. Both ought to be submitted to cupellation. Nevertheless in practice, the treatment is different. The French manufacturers bring to the guarantee offices *unfinished* watches. The assayer has, in this case, every facility for taking away a parcel of gold and proceeding by cupellation, without deteriorating the objects; on such a quantity of articles proceeding from the same melting, he will assay some of them by cupellation and will content himself with the touchstone for the others, but at

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., MARCH, 1865.

11, *Offord Road, N.*

Days of the Month.	Barom. reduced to 32° F. and the sea level.	Temperature in the Shade. At 9 a.m.	Temperature in the Shade. Highest in the previous 24 hours.	Temperature in the Shade. Lowest during the previous 24 hours.	Rainfall.	Wind. Direction.	Wind. Force (scale 0 to 12)	Weather. At 9 a.m.	Weather. During the next 24 hours.
	Inches.	o	o	o	Inch				
1	29·598	44	51	39	0·02	NW	6	cr	c, r
2	·734	45	49	39	0·15	WSW	3	r	c, b
3	30 284	38	47	33	0·04	WSW	3	cb	bc
4	·275	39	46	30	—	W	3	om	c, qr
5	29·640	40	46	32	0·16	SW	6	b	c, r
6	·231	38	45	35	0·07	CALM	0	om	r, bc
7	·642	38	40	33	0·06	WNW	5	b	c
8	·666	37	43	31	0·02	NNE	3	or	csr, bc
9	·941	36·5	41	33	0·05	WNW	5	cs	cbp
10	·983	36	42	32	0 01	W	4	m	r, c
11	·600	41	41	34	0·15	NNE	4	c	o, c
12	30 075	37	42	33	—	NE	3	o	oc
13	·004	38	41	35	—	NNE	1	o	o
14	29·876	36·5	43	34	0·01	NE	3	o	o
15	30·062	35·5	41	34	0·01	NE	3	o	o
16	·081	37	39	33	—	N	2	o	om
17	29·978	37	41	32	—	E	1	o	o
18	30 035	36	43	31	—	E	3	o	o
19	29·881	37	44	32	—	NE	6	o	o, q
20	·932	29·5	40	25	—	E	8	b	b, q
21	30·080	28	34	23	—	E	3	b	bc
22	29 965	34	38	27	—	N	4	cb	cs
23	·899	35	42	30	—	NW	5	s	c, b
24	·839	34 5	43	28	—	NNW	5	b	b, s, c
25	·863	34	42	27	—	WSW	3	bc	r
26	·309	36	42	33	0·23	W	7	r	cs
27	30·020	32·5	39	27	0·05	N	5	b	p, c
28	·092	32·5	40	26	0 08	S	2	o	r. s
29	·068	34	41	30	0·08	SE	2	s	o
30	·282	35	36	28	—	E	2	b	cb
31	·237	41	46	31	—	WSW	2	c	bc, r
	29·906	36·5	42·2	31 3	1·19	N 25 E	1	—	Means.

19th and 20th, a gale from eastward.

26th, a NEly gale with frequent snow squalls.

Severe cold, with snow showers and piercing wind prevailed during the vernal equinox.

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A night pre-eminently *lightless* is one that is *evenly cloudy*, it is never a *stormy* sky, it is, below at least, a tranquil night; and it is genial in temperature, much more so than is often a clear summer's night. A uniform vapoury firmament constitutes the inferior stratum, which at once shuts in the warmth of the planet and shuts out the starry sky. But to render the night thoroughly *dark*, there must be a loftier unbroken expanse of cloud, between which and the lower stratum a space of a mile or two, may intervene.

There is another condition of the atmosphere which is concerned in producing a dark night. The atmosphere is sometimes in a condition to absorb light, and at other times to radiate this light. Duly considering the difference occasioned by more or less of mist or haziness in the atmosphere at different times, and allowing also for what may be due to the presence or the absence of the principal planets, there is a great difference between one starlight night and another, which is attributable to this variable condition of the atmosphere as to the relative amount of latent and of sensible light. If the night be cloudless and the atmosphere free from vapour, and if it be *also* in an absorbent condition as to light, then the azure of the heavens has a peculiar depth of colour, upon the ground of which the constellations shine out as if they were *set* upon the deepest cobalt. But if, instead of this cloudlessness, there be (along with the above mentioned condition of the atmosphere) a sky overcast with compacted clouds, with maybe a second, even a third stratum above this, the occurrence of these several conditions spreads upon the earth indeed a sepulchral shroud.—Abridged from *Good Words*, for February, 1864.

EQUATION OF TIME TABLE

For MAY, 1865.

Day of the Week.	Day of Mth.	At APPARENT NOON. Equation of Time to be *subtracted* from Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *added* to Mean Time.
		m. s.	s.	m. s.
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Tues...	2	3 10·07	0·288	3 10·09
Wed ..	3	3 16·72	0·266	3 16·73
Thurs .	4	3 22·84	0·244	3 22·85
Fri....	5	3 28·42	0·221	3 28·43
Sat....	6	3 33·44	0·198	3 33·45
Sun ...	7	3 37·91	0·175	3 37·92
Mon ..	8	3 41·83	0·152	3 41·84
Tues...	9	3 45·18	0·128	3 45·19
Wed ..	10	3 47·95	0·104	3 47·96
Thurs .	11	3 50·15	0·080	3 50·16
Fri....	12	3 51·78	0·056	3 51·78
Sat....	13	3 52·82	0·031	3 52·82
Sun ..	14	3 53·28	0·006	3 53·28
Mon ..	15	3 53·15	0·018	3 53·15
Tues...	16	3 52·43	0·042	3 52·43
Wed ..	17	3 51·14	0·066	3 51·14
Thurs .	18	3 49·28	0·090	3 49·27
Fri....	19	3 46·84	0·114	3 46·83
Sat....	20	3 43·82	0·138	3 43·81
Sun ...	21	3 40·23	0·161	3 40·22
Mon ..	22	3 36·09	0·184	3 36·08
Tues...	23	3 31·40	0·206	3 31·39
Wed ..	24	3 26·18	0·228	3 26·17
Thurs .	25	3 20·45	0·249	3 20·44
Fri....	26	3 14·23	0·269	3 14·22
Sat....	27	3 7·54	0·288	3 7·52
Sun ...	28	3 0·39	0·307	3 0·37
Mon ..	29	2 52·80	0·325	2 52·78
Tues...	30	2 44·78	0·343	2 44·76
Wed ..	31	2 36·35	0·360	2 36·33

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LECTURE ON THE GREENWICH SYSTEM OF TIME SIGNALS.

By WILLIAM ELLIS, Esq., F.R.A.S., of the Royal Observatory, Greenwich.

(*Continued from page* 102.)

In order that it may be known at Greenwich that the ball at Deal has really been discharged, an arrangement is provided by which the ball reports automatically the fact of its having fallen. When it has nearly completed its descent, a projecting pin on the ball rod comes into contact with, and pushes aside in passing, a small lever, which so acts upon certain contact springs (tapper springs as they are called) that the connexions of wires in the ball room are for an instant changed. The local Deal battery is brought for a moment into circuit with the Greenwich wire, and a signal known as the "return signal" passes to Greenwich. Immediately afterwards, as the ball rod takes up its final position, another projection on the rod pushes aside a detent which had held the switch in the position into which it was brought by the last rise of the ball lever, and instantaneously communication with the ball apparatus is cut off and the ordinary telegraphic loop restored. Soon afterwards the clocks at Ashford and London restore at each place respectively the ordinary telegraphic connexion.

The clock at Ashford being used for the special purpose of daily switching the wires for the necessary ball communication, must necessarily be kept to Greenwich time. The clock is a galvanic clock, similar to the Greenwich normal clock, and is worked by batteries placed in the Ashford station. As the clock occupies a position so isolated, a peculiar method is used for keeping it to time. A gaining rate of a few seconds daily is given to it, so that at 1^h it is always too fast. At $1^h\ 0^m\ 0^s$ of its own time, a circuit is completed in the clock, by which the galvanic currents which should pass from the pendulum to the electro-magnets to work the clock, pass instead by the newly formed short circuit. The clock therefore remains at rest, the pendulum still continuing its vibration. This state of things lasts till $1^h\ 0^m\ 0^s$ true Greenwich time, when the Greenwich 1^h current on its way to Deal, passes through the coils of an electro-magnet placed in the circuit. The action of this electro-magnet breaks the short clock circuit; the clock currents immediately commence to pass by their usual route and the clock begins to advance, showing now Greenwich time or Greenwich time very nearly. The clock continues going until the next day at 1^h when having again gained some seconds, it stops at $1^h\ 0^m\ 0^s$ of its own time until again started by the Greenwich 1^h current, and thus is it kept adjusted so that the special work of the clock, the switching of the wires at 1^h is always performed at the proper time.

A clock is placed in the ball room at Deal, for the guidance of the ball attendant, who keeps it rated by the currents which he receives from Greenwich.

The Deal ball was erected by authority and at the expense of the Lords Commissioners of the Admiralty for the purpose of giving time to shipping in the Downs. It has been in operation since the year 1855, and the success with which it is worked is due principally to the establishment of the "return signal," the non receipt of which immediately shows that something has gone wrong, thus giving the earliest possible notice of the existence of some fault requiring correction if possible before the following day.

It has been mentioned that the London District Telegraph Company distribute to some extent, in London, the signals received by them, but not on such a scale as in the systems already described. They have received hourly signals directly from the Observatory, since the year 1862, and their systems of wires throughout London, undoubtedly give them great facilities for carrying out an extensive system of distribution in London.

We now come specially to consider the application of galvanism to the correction of clocks, and to the regulation or controlling of clocks, as distinguished from the use of it as a motive power (as employed for example, in the Greenwich mean time system of clocks).

Now a single galvanic current may be made to correct once daily the error accumulated in a clock going by its own

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his own risk and peril, seeing that he is responsible for the standard that he declares. It should be the same for imported watches; nevertheless in order to assay them *the touchstone only is generally used*, ALTHOUGH THE CUPELLATION OUGHT TO BE THE RULE. This is the motive. Watches from abroad arrive in France *finished* and furnished with their movements and accessories. To assay them by cupellation is to expose oneself to deteriorate them, as well as to oblige the foreign manufacterers to have in France workshops for repairing and finishing.....This is what we wish to avoid, and is therefore the reason why the assayers limit themselves usually to the touchstone; but in case of the least doubt the assayer ought to have recourse to the rule, that is to say to cupellation."

This language appeared to me sufficiently clear to be transmitted to your Excellency; besides this facility is conceived in the trials of articles of foreign gold-ware, because the stamps applied to them neither indicate nor guarantee the standard.

I believe I have thus answered your Excellency's questions; otherwise it will suffice to have recourse to the text of the law to have the explanation, if it be necessary, of other legal depositions concerning matters of gold or silver.

Accept, my Lord, &c.,
TREITE.

PARIS, *7th March*, 1865.

TRANSMISSION OF TIME SIGNALS.

To the Editor of The Horological Journal.

16, MYDDELTON SQUARE, E.C.,
February 22nd, 1865.

Dear Sir,—During a short stay I made in Switzerland last year, I saw in the watch manufacturing districts of the Canton of Neuchâtel, an ingenious contrivance for appreciating the fractions of seconds in the reception of electric time signals. I am not aware of such an apparatus being used, or even known, elsewhere; hence I think that a description of it may interest your readers, even if it has no further use. In order to give a correct account of the method employed, I applied to Dr. Hirsch, the Director of the Cantonal Observatory at Neuchâtel, who most obligingly complied with my request, and moreover has given a full explanation of their system. The following is a translation of his communication.

Your's very truly,
CHARLES GUILLAUME.

NEUCHATEL, *2nd February*, 1865.

To Mr. Charles Guillaume, London.

Sir,—I have great pleasure in supplying you with the information you desire respecting the transmission of time signals here.

Two years ago I published in the "Bulletins de la Société des Sciences de Neuchâtel," a communication upon the *electric* part of that system; and as you may like to have it at hand, I take the liberty to send you a copy of it.

Respecting the means I used for the *reception* of time at the several stations, there were two things I wanted to secure, as being important to our watchmakers: First, that our signals (which by most careful sidereal observations, have an accuracy that reduces any possible error to less than $0^s.1$), should not lose that accuracy by an uncertain observation at their *reception;* Secondly, that watchmakers should not be bound to a fixed hour to have correct time; but that they should be able to rate their chronometers with sufficient accuracy at any time of the day.

To obtain those two desiderata, it was necessary to abandon the systems generally adopted, such as the dropping of a ball, or the firing of a gun.

In order to have *permanent* correct time, it was indispensable to have a good regulator, either at the watchmaker's house, or in some public building; and that the rate of the regulator itself should be checked by the signal of observation, and registered in a table, together with the correction; so that correct time could be obtainable at any hour of the day, by an easy calculation. Our signal is given at 1 p.m. Now suppose that a watchmaker comes at 5 p.m., and finds that his chronometer is $24^s.6$ fast by the regulator; in referring to the table of rate he finds, for instance, that at 1 p.m., on the same day the regulator was $37^s.25$ slow, and the daily rate for the last 24 hours was $+ 0^s.36$; if the regulator is a good one, there will not be a difference of more than 2 or 3 tenths of a second from one day to the other; the observer will then be enabled to make his reckoning, with a maximum chance of error of only one-

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twentieth of a second; and will find as the correction of the regulator at 5 p.m., —37ˢ·19, which will give —12 ·59 for his chronometer.

In order, however, to get these results with a maximum possibility of error not exceeding 0ˢ·1, it is necessary that the observations of the signals be registered with an accuracy at least superior to this. To secure that accuracy, I have used the system of *coincidence*, (methode de coincidence,) which, as you had the opportunity of seeing, allows, with only ordinary care, of a remarkable precision of observation; in fact, it is to the ear, what the vernier is to the eye. The principle is this: Side by side with the regulator (beating the seconds,) is a clock which we call "Clock of Coincidence," so regulated as to give 60 beats in 59 seconds. The duration of each oscillation being shorter than the regulator's, by one-sixtieth of a second, this clock will gain upon the regulator one-sixtieth per second. If then the two clocks, at a given moment, beat exactly together, their beats, at the next second, will be one-sixtieth apart, at the next, two-sixtieths, at the third, three-sixtieths, and so on; so that in one minute the clock will have gained sixty-sixtieths, *i.e.* one second, and the beats will again occur simultaneously. It is this *coincidence*, occurring once in a minute, which is to be observed; and as it does not require a remarkably trained ear to ascertain within two or three oscillations when the coincidence takes place, the maximum of error will be less than three-sixtieths of a second, or 0ˢ·05.

Suppose now the clock of coincidence, or signal clock, started precisely at the arrival of the signal, by the electric current itself; if that instant does not coincide exactly with a complete second of the regulator, or Normal Clock, (which will seldom be the case,) the two clocks will not beat together, but the difference will be lessened by one sixtieth of a second at every beat, until the signal clock overtakes the regulator. *The number of seconds elapsing until the moment of Coincidence, give the number of sixtieths of seconds to be added to the last full second counted at the arrival of the signal.* For instance, if the coincidence takes place at the eighteenth oscillation of the clock, it is that the clock was started eighteen-sixtieths, or 0ˢ·3 later than the last full second of the regulator, as it had to gain eighteen times one sixtieth of a second to overtake it. All that the observer has to do, is to count the last second previous to the deflection of the needle. Supposing he has found the normal clock to mark at that moment 1h. 0m. 23s., and a fraction, he must now listen to the beats of the two clocks, to catch the instant of coincidence; and he must, at the same time, watch the hand of the *signal clock*, to know how many seconds elapse between the arrival of the signal and the instant of coincidence. We will say the hand points to twelve when the beats coincide; the observer then knows that the signal clock was started twelve-sixtieths of a second, or 0ˢ·2, after the twenty-third full second of the normal clock, and consequently that this clock is + 23ˢ·2. This observation he records on the table of rate.

As decimal fractions are the most convenient, these sixtieths are reduced to hundredths, and a reduction table is placed in the observation room.

For the construction of the signal clock, we have simply adopted the half-second pendulum, with spring, and the lost beat escapement (échappement à coup perdu) so that it gives the seconds. The clock is made to go for about twenty minutes only; as it is merely required to go for one or two minutes a day. Near the lower extremity of the pendulum is placed an electro magnet, to the armature of which the pendulum is locked, until released by the electric current at the moment of the transmission of the signal, when the clock starts.

After the observation is completed, the clock is wound up again, and stopped, (by locking the pendulum to the magnet), and the hand set at sixty; ready for the next days operation.

With those explanations the system will, I believe, be clearly understood, and could, if required, be established in London. This method is, no doubt, the most correct in use for the reception of time signals; and is appreciated by our horologists. It is now established at Berne, Chaux-de-fond, Locle, Ponts and Fleurier, and at several private houses.

DR. AD. HIRSCH.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., MARCH, 1865.

11, *Offord Road, N.*

Days of the Month.	Barom. reduced to 32o F. and the sea level.	Temperature in the Shade. At 9 a.m.	Temperature in the Shade. Highest in the previous 24 hours.	Temperature in the Shade. Lowest during the previous 24 hours.	Rainfall.	Wind. Direction.	Wind. Force (scale of 0 to 12)	Weather. At 9 a.m.	Weather. During the next 24 hours.
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(*Continued from page* 102.)

In order that it may be known at Greenwich that the ball at Deal has really been discharged, an arrangement is provided by which the ball reports automatically the fact of its having fallen. When it has nearly completed its descent, a projecting pin on the ball rod comes into contact with, and pushes aside in passing, a small lever, which so acts upon certain contact springs (tapper springs as they are called) that the connexions of wires in the ball room are for an instant changed. The local Deal battery is brought for a moment into circuit with the Greenwich wire, and a signal known as the "return signal" passes to Greenwich. Immediately afterwards, as the ball rod takes up its final position, another projection on the rod pushes aside a detent which had held the switch in the position into which it was brought by the last rise of the ball lever, and instantaneously communication with the ball apparatus is cut off and the ordinary telegraphic loop restored. Soon afterwards the clocks at Ashford and London restore at each place respectively the ordinary telegraphic connexion.

The clock at Ashford being used for the special purpose of daily switching the wires for the necessary ball communication, must necessarily be kept to Greenwich time. The clock is a galvanic clock, similar to the Greenwich normal clock, and is worked by batteries placed in the Ashford station. As the clock occupies a position so isolated, a peculiar method is used for keeping it to time. A gaining rate of a few seconds daily is given to it, so that at 1^h it is always too fast. At $1^h\ 0^m\ 0^s$ of its own time, a circuit is completed in the clock, by which the galvanic currents which should pass from the pendulum to the electro-magnets to work the clock, pass instead by the newly formed short circuit. The clock therefore remains at rest, the pendulum still continuing its vibration. This state of things lasts till $1^h\ 0^m\ 0^s$ true Greenwich time, when the Greenwich 1^h current on its way to Deal, passes through the coils of an electro-magnet placed in the circuit. The action of this electro-magnet breaks the short clock circuit; the clock currents immediately commence to pass by their usual route and the clock begins to advance, showing now Greenwich time or Greenwich time very nearly. The clock continues going until the next day at 1^h when having again gained some seconds, it stops at $1^h\ 0^m\ 0^s$ of its own time until again started by the Greenwich 1^h current, and thus is it kept adjusted so that the special work of the clock, the switching of the wires at 1^h is always performed at the proper time.

A clock is placed in the ball room at Deal, for the guidance of the ball attendant, who keeps it rated by the currents which he receives from Greenwich.

The Deal ball was erected by authority and at the expense of the Lords Commissioners of the Admiralty for the purpose of giving time to shipping in the Downs. It has been in operation since the year 1855, and the success with which it is worked is due principally to the establishment of the "return signal," the non receipt of which immediately shows that something has gone wrong, thus giving the earliest possible notice of the existence of some fault requiring correction if possible before the following day.

It has been mentioned that the London District Telegraph Company distribute to some extent, in London, the signals received by them, but not on such a scale as in the systems already described. They have received hourly signals directly from the Observatory, since the year 1862, and their systems of wires throughout London, undoubtedly give them great facilities for carrying out an extensive system of distribution in London.

We now come specially to consider the application of galvanism to the correction of clocks, and to the regulation or controlling of clocks, as distinguished from the use of it as a motive power (as employed for example, in the Greenwich mean time system of clocks).

Now a single galvanic current may be made to correct once daily the error accumulated in a clock going by its own

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independent power, or the pendulum of the clock may be regulated continuously by a galvanic current given at every second of time. The first of these principles is used to correct the Ashford clock as already mentioned; it has been employed also for certain of the Post Office clocks in the following way. The wire which passes from the Observatory to the Electric and International Telegraph Company, is extended in London to the Post Office, and to the great clock at Westminster, and the correction of the Post Office clocks is made by the current which passes from the Observatory on this wire at noon. But at present the system is only partly in use; great changes having been made in the Post Office, some of the communicating wires within the building were disturbed, and have not yet been reinstated. For clocks showing seconds the correction is effected in the following manner. The escape wheel of the clock to be corrected, instead of being rigidly fixed to its spindle, is attached by click and ratchet only, so that the whole train of wheels including the hands can be moved in one direction (backward) without disturbing the escape wheel. This allows the train and hands to be set backward at any time, independently of the escape wheel, whilst the ordinary forward motion of the train of course carries forward also the escape wheel in the usual manner, and maintains the pendulum in vibration. A daily gaining rate of a few seconds is given to the clock; at noon Greenwich time it is therefore too fast. Now in the 24 hours preceding, the clock has been, by a snail, raising a weighted lever, which is lodged shortly before noon in such a position, that the galvanic current at noon, acting by an electro-magnet, discharges the lever, which acting through an additional lever drives round (backward) a short arm attached to the seconds' hand spindle, which is brought into a definite position such that the seconds' hand stands at 60 seconds. The motion of the seconds' spindle is communicated by the train to the minute and hour hands, but the escape wheel is not disturbed. The weighted lever at the same instant drops off the end of the additional lever, which being counterpoised rises, leaving the clock free to advance. The clock then shows Greenwich time, corresponding with that of the Greenwich clock, from which the current originates. By noon of the day following it will be again too fast, and be again similarly corrected by the galvanic current. For clocks showing minutes only, the correction is made to the motion work, and the mechanism is more simple. A **V** shaped piece is set on the pipe which carries the minute hand, and the galvanic current acting by an electro-magnet, presses a roller into the angle of this **V** piece, and brings the minute hand exactly to 60 minutes. For correction in this way it is immaterial whether the clock be gaining or losing. The clocks thus corrected are divided into several groups, each group including numerous clocks. The galvanic current which actually makes the correction, is not the direct Greenwich current, but a local current, brought into action by relay, there being a separate relay current for each group of clocks.

Now it becomes necessary that there should be some check on the performance of the mechanism. It is therefore arranged that the principal clock of each group shall, at a certain minute and second of its own time, in the hour preceding noon, and again at the same definite minute and second in the hour following noon, transmit a signal to Greenwich. Different times are selected for different clocks. Observation of the time at which the first current arrives at Greenwich shows the amount of error accumulated in each instance since the preceding day; observation of the second current similarly shows whether the correction by the noon current was properly made. To enable the clocks to give these signals, the Westminster clock, the last in the series, removes for a time the ordinary earth connexion of the extreme end of the wire, and during the same period the Greenwich clock permanently connects a battery to the Greenwich end. The signals are then given by the respective clocks making a momentary earth connexion, by means of a combination of contact springs similar in principle to those in the Greenwich normal clock.

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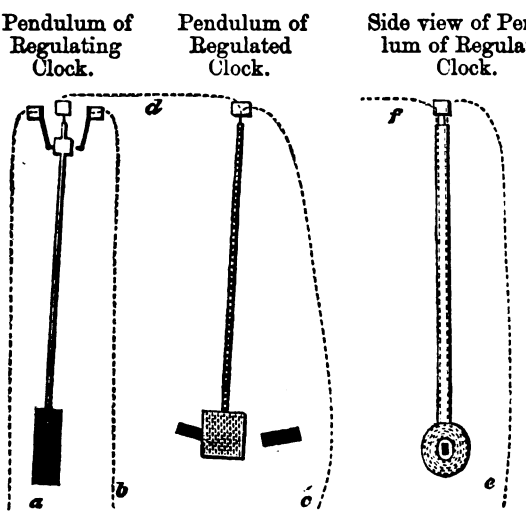
The principal clock of each group only, gives a signal; if it is found to have been corrected, it is assumed that all the remaining clocks of the group were also corrected, since the correction of the principal clock is evidence that the galvanic current acted. This Post Office system was commenced in 1856, and was extended in 1858, but is only partly in operation at the present time, for the reason already given. Hourly time signals are however regularly received at the Post Office, by which at present the clocks are kept to time.

The Westminster clock is made now to report also its behaviour to Greenwich, and so it has done since the year 1862, although no apparatus has yet been applied for correcting or regulating it by a galvanic current. The signals daily received from the clock are, one at $11^h\ 38^m\ 0^s$ A. M., and one at $0^h\ 38^m\ 0^s$ P. M., of the clock's own time, and observation of these signals at Greenwich shows the error of the clock. All the hourly time signals given from Greenwich on this wire pass to the clock tower, those persons who have charge of the clock can thus at any time ascertain the error of the clock by watching for one of these signals. It will be interesting to you to know that the independent performance of the clock is extremely good. It is kept within one or two seconds of true time, and its rate is changed, as found necessary, by adding to or removing from the pendulum, small weights.

Of the plan of using a galvanic current to regulate continuously an independent clock, I have now to speak. The perfecting of this plan is due to Mr. R. L. Jones, manager of the railway station, at Chester. He, in using clocks in which the motive power was galvanism, was led to consider whether, on account of the amount of battery power required, and the annoyance of stoppage by occasional break down of the batteries, it would not be possible to employ the galvanic current more advantageously as a regulator only, giving up its use entirely as the motive power. After various experiments he was at last led to a plan perfectly successful, for which he obtained a patent in 1857. In his arrangement, currents from a central clock are made to regulate other clocks in the following manner. The bob of the pendulum of the clock to be regulated is composed of a hollow coil of wire, the hollow being placed horizontal. The wires from the coil pass up and away from the pendulum by a double pendulum spring. Two permanent bar magnets having similar poles in proximity, are fixed in a horizontal position to the clock case, one on each side of the pendulum, and are so placed that the pendulum coil in its vibration passes on to and encircles each magnet alternately. Instead of two magnets, two bundles, each consisting of several magnets, are I believe usually employed. Currents of opposite kinds being now sent at successive seconds (as in Shepherd's clocks) from the regulating

Fig. 9.—Jones's system of Clock Regulation.



The wire *a* comes from the copper pole of one battery, the wire *b* from the zinc pole of another; *c* is in connection with earth; *e* and *f* represent the same wires as *c* and *d*.

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clock to the pendulum coil of the regulated clock, if the independent rate of the latter, that is, with no current acting, be small, then, with currents passing, the action between the coil and the fixed magnets is such, that the pendulum of the regulated clock will be accelerated if losing, and retarded if gaining, and will thus be kept in complete sympathy with the pendulum of the clock from which the galvanic currents originate. Reference to the preceding diagram, in which the pendulums only of the clocks are shown, will make the description here given more clear. A number of clocks may be placed in one circuit, and they will all be similarly regulated. The advantage of employing the galvanic current in this way is evident, for in case of failure of a wire or failure in the battery, the regulated clocks do not stop as is the case when the current itself is the motive power; they merely begin, from the time of cessation of the current, to advance, each with its own independent rate, instead of being controlled by the regulating clock, a small inconvenience as compared with the complete stoppage of the clocks which takes place when their advance is entirely dependent on the galvanic currents. And this is more especially the case for a clock used for a purpose such as that at London Bridge for switching wires, for it would make the whole difference between success and failure in joining on wires to pass on time signals. With the clock driven by galvanism, on stoppage of the current there would be stoppage of the clock, and a break down of the signals, but with the clock going by its own independent power, and regulated only by galvanism, on stoppage of the current, the clock would continue to switch on the wires to allow the time signals to pass, until it had by its own independent rate accumulated such an error as exceeded that certain margin or interval of time during which for greater safety the wires are allowed to remain in connexion; but before this, the failure of the battery would probably have been discovered, the battery renewed, and the clock again put under regulation, without causing failure of any of the time signals themselves. Moreover to effect regulation a small battery is sufficient.

The only external clocks regulated by galvanic current from the Observatory are, the London Bridge switch clock, and a clock established by Messrs. De La Rue, at their factory in Bunhill Row: this latter clock is constructed and regulated precisely on Jones's plan, the former on the same principle of using the galvanic current only to regulate the clock, but with a different plan, one contrived by Mr. Walker and described by him in the *Monthly Notices* of the Royal Astronomical Society, vol. xxi, page 74. The switch clock itself is still worked by galvanism, but the contacts, instead of being made by the Greenwich clock (as they once were) are made by a clock (converted from a galvanic clock into a pendulum clock) placed beside the switch clock at London, this pendulum clock being regulated by the currents given from Greenwich. The following is a brief description of the arrangement for regulation, which Mr. Walker adopted in this form in order to employ certain pre-existing galvanic parts. A brass bar is fixed in a horizontal position to the arbor that carries the crutch. At one end of the brass bar is fixed, at right angles, a bar of soft iron, also in a horizontal position; at the other end is a counterpoise. The iron bar is situated above the poles of an electro-magnet, part of the original galvanic clock. The regulating currents pass through the coils of the electro-magnet, and, attracting the iron bar, act through the crutch on the pendulum, and so control the clock. The currents are given from Greenwich by the seconds' relay (shown at G, Fig. 4) which moves in sympathy with the normal mean time clock. Messrs. De La Rue's clock is situated on an extension of the wire which passes to the London Bridge clock. Currents at each alternate second only are employed, those at 0^s, 2^s, 4^s, &c., which are found to be sufficient. In order to give means of checking the accuracy of the time shown by these clocks, an arrangement exists by which the Greenwich apparatus breaks the communication at the 0^s and 2^s commencing each hour, the first current given after the hour being at 4^s. The proper correspondence of these omitted currents at the regulated clocks gives certain proof of their being in sympathy with the Greenwich clock.

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In speaking of the sidereal system of clocks in the Observatory at Greenwich, I mentioned that there was one clock regulated by the transit clock on Jones's system. The transit clock has a seconds' pendulum, and the regulated clock has a half seconds' pendulum. But there is one especial point of difference. Instead of fixing the coil to the pendulum and the magnet to the clock case, as in Jones's plan, the coil is fixed to the clock case, and the magnet attached to the pendulum. The regulation, with this alteration, with clock gaining or clock losing, is perfectly successful, and the clock being provided with a compensated pendulum is, independently, a good time-keeper, an advantage of which the benefit is felt whenever in case of accidental failure of the current it becomes necessary to rely on the clock uncontrolled.

The various applications of galvanism to clocks that have now been described may each be supposed to be the type of a particular system, and these systems divide themselves into two distinct classes: in one the galvanic current is itself the motive power, in the other it is used only as an auxiliary, either to correct or continuously regulate clocks going by independent power of their own. The system of clocks on Shepherd's plan established at the Royal Observatory is a type of the first mentioned class; in this system one pendulum determines the time of passage of currents to act on many clocks, the whole advancing together beat by beat, and this is a very convenient arrangement for clocks not too widely separated, as for instance, when placed in the different rooms of one large building, for by accelerating or retarding the governing pendulum, the whole of the clocks are altered simultaneously, and, in case of suspicion of error in any one of the clocks, reference to the fundamental clock is easy. But although so satisfactory within limited distances, the system is not to be recommended for clocks very far distant from each other, when reference to the fundamental clock is not easy. To show however what has been done, I may mention that the London Bridge switch clock, six miles from the Royal Observatory (by the route as then existing), was for several years worked from Greenwich on this system with wonderful regularity. Mr. Walker, who in the hourly time signals had the means of periodically testing the accuracy of the time shown by the clock says, "While the gutta percha wire was new and in good condition, which was for a considerable time, the London clock would, for weeks, and often for months together, continue to show the same second as the Greenwich clock. We were able to verify this by the hourly time signals on the other wire." The system failed through defects in the communicating wire (an underground wire) which wire was however with others superseded by overhouse wires as already mentioned. With the new wire the system might have been continued, but it was decided (for reasons which have already appeared) to use the current as a regulating power only. The plan adopted, arranged entirely by Mr. Walker, has been already described.

As instances of using the galvanic current as an auxiliary only, three methods have been mentioned; one in which the signals received are used to rate and keep to time a clock to which no mechanism for mechanical correction or galvanic regulation is attached, as in the Westminster clock; another in which the error of the clock accumulates during 24 hours, and is then corrected, as in the Post Office clocks, and in the Ashford switch clock; and another in which the clock is continuously regulated, as in the London Bridge switch clock and Messrs De La Rue's clock.

The first method is very simple. The entire use of a communicating wire is not required. Time signals begin received at the clock, direct comparison of the clock with any one of the signals shows its error. And thus the rate can be occasionally slightly changed as necessary, so as to keep the error always small.

In the second method, in which the accumulated error is corrected once daily, the use of a communicating wire is only required for a short time every day. Such a plan can be applied to any ordinary clock, although additional mechanism in the clock is necessary. And if the small error which may accumulate before the

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time of correction be not considered important, the plan is one which may be advantageously used, when, on account of the want of the entire use of a communicating wire, the plan of continuous regulation, the best of all methods of using the galvanic current as an auxiliary, cannot be employed.

To this latter method, it is now only necessary to refer. Clocks so regulated all move together, beat by beat, with the fundamental clock. The entire use of a communicating wire is however required. The system can be applied to clocks at any distance, and is in such cases, especially advantageous. For as the galvanic current merely corrects the small tendency which each distant clock has to deviate from the fundamental clock, the interruption of the currents for a short time (suppose to change a battery or renew a connexion) causes little inconvenience, since from the time of such cessation, the clocks, no longer controlled, will merely begin to deviate slightly (each according to its own particular rate) from the regulating clock, and if the currents are not too long interrupted, each pendulum will be brought back to coincidence without accumulating any error at all. It is immaterial whether the regulated clocks have gaining or losing rates, some may be gaining, others losing, in all cases the pendulums will be entirely controlled. It must however be mentioned that the method can only be applied to a clock having a pendulum either similar to that of the regulating clock, or one in which the relation to that of the regulating clock may be expressed by some simple multiple, as for instance when the method is applied to regulate a pendulum made to vibrate in half the time or in double the time of that of the fundamental clock.

(To be concluded next month.)

A WORD ON CLOCKS.—Ingenious men of all ages, from Archimedes, 200 years B.C., to Wallingford, at the commencement of the 14th century, have been cited as the inventors of the clock. The fact is that the clock, like almost every other useful implement, gradually grew to perfection: one man suggested wheelwork; another the weight for maintaining or driving power; another the balance for regulating the expenditure of that power; another the dial and hands; another the striking parts, and so on; and at last one man combined all together in one machine, and gained the credit of making the first clock. This man appears to have been one Henry de Wick, or de Vick, who placed a clock in the tower of the Palace of Charles the Fifth, about the year 1364, which clock is the most ancient of which there exists any particular description. The principles upon which it was constructed were essentially the same as those of the clocks of the present day; that is, there was a moving power and a regulating power. The moving power was a weight hung to a cord, wound round a barrel, the unwinding of which, by the fall of the weight, gave motion to a train of wheels that moved the hands around the dial. The regulating power was a balance-wheel, springing backwards and forwards after the manner of the watch-balance, so familiar to us all.—*The Shilling Magazine.*

Sterrometal, from the Greek word signifying tough or firm, is composed of copper, spelter, iron, and tin, in proportions that may be slightly varied without much affecting the result. In colour it resembles brass rather than gun metal; it is very close in its grain, and free from porosity. It possesses considerable hardness, and will take a very fine polish. Several eminent Vienna engineers have tried it for the cylinders of hydraulic presses with great success. Two specimens of the alloy have been submitted to rigorous tests by the Polytechnic Institute of Vienna and the Imperial Arsenal. The proportions used in each case were the following:—

	Polytechnic Institution.	Imperial Arsenal
Copper	55·04	57·63
Spelter	42·36	40·22
Iron	1·77	1·86
Tin	0·83	0·15
	100·000	99·86

The specimen tested at the Polytechnic Institute gave the following results per sectional inch (English):—A bar prepared by simple fusion, bore a weight of twenty-seven tons. Forged red hot it broke at thirty-four tons. Drawn cold, at thirty-eight tons; the figures in the case of the specimen tried at the Imperial Arsenal being twenty-eight, thirty-two, and thirty-seven tons respectively; while the best English gun-metal, containing ten per cent. of tin and ninety per cent. of copper, broke at eighteen tons under similar circumstances. The specific gravity of the metal is about 8·37 when forged hot.

These results, which are official, are truly astounding when we consider that the average breaking strain of wrought iron, as given by Mr. Anderson, of Woolwich Arsenal, is but twenty-six tons, whilst that of the best steel is only thirty-five tons per sectional inch. The elasticity of the sterrometal is also very great. It may be stretched 1-600th of its length without undergoing permanent elongation; gun-metal giving only 1-590th, and wrought-iron 1-1500th. No surprise is, therefore, felt when we are told that a tube of sterrometal is capable of resisting a pressure of 763 atmospheres, a tube of wrought-iron of similar size and form giving way under 267.—*English Mechanic.*

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FURTHER PROCEEDINGS
ON THE
QUESTION OF HALL MARK.

May 16th, 1865.

The Council of the Institute, accompanied by other gentlemen named to the deputation by the public meeting on the question of Hall Marking, had an interview with Sir George Grey at the Home Office, for the purpose of submitting to the Home Secretary the substance of the resolutions which have been already published as passed at the public meeting. The deputation was introduced by Sir Morton Peto.

Sir George Grey listened with attention to the details of the case, and answered that though he had a distinct idea of the merits of the application, yet he did not feel it lay with his department to interfere. On its being explained, however, that it fell within the home secretary's office to superintend the working of laws professedly passed for prevention of fraud, and that on application at the Board of Trade the matter had been referred by the officers of the board to the Home Office, he consented to see Mr. Milner Gibson, the President of the Board of Trade, on the subject, and would report to Sir Morton Peto the result of their conference.

The following gentlemen formed the deputation:

Mr. Jno. Jones	Mr. H. Bickley
,, D. Glasgow	,, A. Nicole
,, S. Jackson	,, G. E. Mylne
,, E. Storer	,, W. Bailey
,, C. Lange	,, Thos. Holdstock
,, G. Prickett	,, Jno. Evans
,, Josh. Leaver	,, Jno. T. Murray

and Mr. Jno. Moore, *Secretary*.

Exhibition of Manufactures and Art Workmanship, and generally of the Productions of North-east London:—A prospectus of this EXHIBITION which is to be held at the AGRICULTURAL HALL, in August next, will be found among our advertisements. Being strictly local it especially concerns our readers and horologists resident in the locality. It is to be hoped that it will receive a cordial support for the credit and reputation of the district.

BRITISH HOROLOGICAL INSTITUTE.
THE ANNUAL DINNER.

(*Concluded from page* 104.)

Mr. J. JONES also acknowledged the toast of Prosperity to the Horological Institute, proposed by the Chairman, and in so doing made a long and eloquent speech. He remarked that no unfriendly rivalry existed between England and Switzerland, for it was at the cost of England that Swiss Institutions had been preserved free, which favored cheap government and cheap production; and the energy of our mariners had furnished the markets of the East to her manufacturers. The department of the English manufacturer was rather in the higher walks of the art of Horology. Advancing civilization created keener wants, and the business of the Horological Institute was to keep the Horological art level with every requirement that civilization prefers. No nation in the world had reached so near to perfection in time-keeping as those who were present at the meeting then assembled. He hoped that the noble chairman, to whom they were all under obligations for his attendance that evening, would hear and know more of the Institute, and that its members would become better acquainted with him. He then proceeded to speak of the benefits conferred by the Institute upon the trade, and asked for donations and subscriptions in its behalf, in order that it might be enabled effectually to perform the great objects it had in view. Among the fashions of the day was a semi benevolent patronage of the working classes under the form of Public Exhibitions of their works. The Institute, however, took a more honorable estimate of the workman's position without affecting any beneficence; it treated all members of the trade as on a common level; whether a man were worth 30*s*. per week or £100 per week his influence in the council and in the Institute was equal with that of every other member, his opinion and his vote were both governed by the division of the majority. On this account especially should the workmen of the trade, as they value their dignity, co-operate with the Institute in its general object to advance the art and the social position of its members. He hoped that after the proceedings of the evening were over, the noble chairman would be able to say to his friends that he never met with a more intelligent or loyal set of people than the watchmakers of Clerkenwell.

Mr. GLASGOW proposed "Prosperity and better times to the working men of Clerkenwell." He would not have proposed such a toast were he not under the impression that the working men of Clerkenwell had not been dealt by so well as they ought to have been. In reference to an observation which fell from the chairman, he had to say that the working men of Clerkenwell could temper steel better than any other workmen in the world. There was no secret in watchmaking, and all patents relating to it were humbug. If the workmen had done as little for the science of watch-

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making as the masters, he believed that Clerkenwell would have lost the trade long ago. He was speaking as a watch manufacturer when he said that the workmen in the trade were not paid according to their merits. And while he believed that there was much to be learned from the Swiss, he hoped that England would never sit down to attempt to compete with the rubbish of American clocks and Swiss watches. He thought they might get up a watchmakers' exhibition in the Horological Institute, which would be of great advantage to the trade. In his opinion, there was a latent talent in the watch trade wholly unknown, but which ought to be brought out. And he hoped the day was not far distant when there would be a horological exhibition or examination instituted. The annual trials of marine chronometers at Greenwich had given such an impetus to that branch of the trade that no other nation could compete with us either in price or quality. He had much pleasure in proposing, "Prosperity and Success to the working men of Clerkenwell.

The CHAIRMAN proposed "The Arts and Sciences," coupled with the name of Mr. John Bennett.

Mr. BENNETT acknowledged the compliment. He said that he felt much gratified in taking part in the proceedings of the annual meeting of the Horological Institute, which, in his opinion, wanted the help of every one who could do it the least good. For years he had laboured to establish some such institution as the Horological Institute proved to be. He regretted the Institute had not done more than it had. He contradicted the statement that we were superior to the Swiss in watchmaking, for ten Swiss watches to one English were purchased at his establisment, and the purchasers did not afterwards regret they had purchased Swiss instead of English watches. There were men in that room who knew it was all stuff to say that all foreign watches were rubbish, and that they did not keep time. He said that the clock trade was becoming a very important trade, and they must look at what was being done in foreign countries. As to watches, they should not only look after excellence, price, and time-keeping, but also form.

Mr. JACKSON, the treasurer, then read the following list of donations made that evening:—

	£.	s.	d.
Right Hon. the Earl of Caithness....	10	10	0
Valentine Knight, Esq., J.P.....	10	10	0
J. W. Knight, Esq.....	5	5	0
S. Jackson, Esq.....	5	5	0
E. D. Johnson, Esq., F.R.A.S.....	5	5	0
Baron L. N. de Rothschild.....	5	0	0
John Jones, Esq.....	5	0	0
John Bennett, F.R.A.S.....	3	3	0
Mr. John Hutton.....	2	2	0
,, J. C. Klaftenberger	2	2	0
,, E. J. Thompson	2	2	0
,, W. Dempster	1	1	0
,, D. Glasgow	1	1	0
,, J. Gowland	1	1	0
Carried forward ...	59	7	0

	£	s.	d.
Brought forward	59	7	0
Mr. C. B. Holliday.....	1	1	0
,, Howasser	1	1	0
,, V. Kullberg	1	1	0
,, C. Lange	1	1	0
Messrs Macdonald & Neal	1	1	0
Mr. Denis Mc Donnell	1	1	0
,, G. E. Mylne	1	1	0
,, J. Pitkeithly	1	1	0
,, G. J. Prickett	1	1	0
,, Sachs	1	1	0
,, W. G. Schoof.....	1	1	0
,, E. Storer	1	1	0
,, W. T. M. Torrens.....	1	1	0
,, Twitchings.....	1	1	0
,, Wace	1	1	0
,, F. R. Warman	1	1	0
,, W. S. Wilson	1	1	0
,, R. Webster.....	1	1	0
Mon. A. Brocot.....	1	0	0
Mr. Bonetto	0	10	6
,, W. B. Crisp	0	10	6
,, J. W. Dosell	0	10	6
,, J. N. Foster	0	10	6
,, Hickman	0	10	6
,, E. Klaftenberger	0	10	6
,, J. C. Laws.....	0	10	6
,, Lecluse	0	10	6
,, C. Merrill	0	10	6
,, C. Reinecker.....	0	10	6
,, de Santz	0	10	6
,, A. Straiton.....	0	10	6
,, W. J. Smith	0	10	6
,, J. L. Tilling	0	10	6
,, W. R. Virgoe	0	10	6
,, H. G. Webb	0	10	6
,, H. Bickley.....	0	10	0
,, Dornburg	0	10	0
,, S. Holdsworth	0	10	0
,, John Beavis	0	5	0
,, D. Gunton.....	0	5	0
,, R. Haswell.....	0	5	0
,, Holdstock	0	5	0
,, M. L. Muller.....	0	5	0
,, J. Partridge	0	5	0
,, R. Strachan	0	5	0
,, A. Thickbroom	0	5	0
,, J. C. Tribe.....	0	5	0
,, Bishopp	0	2	6
	£91	10	6

Mr. VALENTINE KNIGHT said ingratitude was so high a crime that there had never yet been found the man who would acknowledge himself guilty. And he thought the members of the Horological Institute would be guilty of deep ingratitude, if they did not thank the noble chairman for the kind and excellent manner in which he had presided over them that evening. The great pains he had taken to prepare himself for the meeting, the arguments he had advanced in reference to the trade, and his kindness of manner—the *suaviter in modo*—must have been noticed by all. He proposed the health of the chairman.

The toast having been drank with great applause,

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the CHAIRMAN having briefly returned thanks, and then proposed "Our foreign friends."

Mr. KLAFTENBERGER acknowledged the compliment; and added that their foreign friends made what was not made in this country, and were happy to be useful to them, they therefore ought to be thankful to their foreign friends.

Mr. S. JACKSON proposed the health of Mr. Strachan, the editor of the "Horological Journal."

Mr. STRACHAN said, the cordial manner in which the toast had been received called for his humble acknowledgment, and sincere thanks; but he could not accept entirely the flattering eulogy of their highly respected Treasurer. That gentleman had himself edited a volume of the Journal, and shown that a practical horologist could bring a high degree of literary talent to the conduct of a class periodical of a scientific character. Were it not for the kindly assistance and prompt advice of the Journal Committee he could not hope to conduct the Journal to their satisfaction. He, therefore, only desired to share their approbation with the other members of that committee. Having taken an active part in a former volume of the Journal he could compare past with present experience, and congratulated the members of the Institute that in the seventh year of the existence of their Journal, the interest taken in it by the trade and the public had in no degree diminished, and it could safely be said that a large amount of valuable and practical information had thus been disseminated, which would, most of it, never have been made public but for the existence of the Horological Institute. Viewing the Journal from the first to the last number, and considering that it was entirely the efforts of gratuitous contributors, he said without fear of contradiction, that it was creditable to the Institute, and worthy of the patronage of every one interested in the art, science, and mystery of horology, and that it might go on and prosper should be the wish of all true friends to progress. There was an old rhyme which said,

> "The paltry watch in private pocket borne,
> Misleads but him alone by whom 'tis worn;
> But turret clocks, which towers and spires display,
> By going wrong lead half the town astray."

Now the Institute did not ignore this sentiment: for its object was to promote the science and practice of horology; and its members were desirous of fostering and encouraging solidity, durability, excellence of finish and beauty of design, in the manufacture of watches; and its Journal was always open for descriptions or accounts of inventions, improvements, methods of manipulation, and processes, relating to all kinds of watches. All the well-known chronometer makers were members, and their aim was absolute precision in their timepieces. The Journal helped them usefully, for it gave increased circulation to the reports of the Astronomer Royal, and of Mr. Hartnup, and he was proud to be able to say that as regarded the Greenwich trials, although the prizes were few and the blanks many, yet he never heard the least complaint, or expression of envy or jealousy, from any member of the Institute, because its Journal gave an extensive publicity to the names of those who got the honors. This was a pleasing feature in the Institute, and a complete refutation to most of the insinuations that have been made, as to the Council being actuated by other than disinterested motives. No doubt the Greenwich trials, and the Liverpool test, tend to maintain that excellence for which our chronometers are so eminent. The former was instituted ostensibly for the purpose of ensuring good chronometers for the royal navy, and to compete was regarded as a privilege by the makers. But the latter was quite optional, and had to be paid for; and, although from commerce and rivalry arguments could readily be drawn in disfavor of it, yet it was accepted by the trade, as well as desired by the mariner, because it was felt that its influence in maintaining the standard of production was highly valuable to this country, and our mariners, and those of other nations, could proceed to sea with English chronometers, knowing them to be friends in whom they could place confidence. In reference to the Admiralty chronometers, it was well known the officers in charge of them while at sea were required to keep a record of the rates with the maximum and minimum temperature in which they performed, but nothing appeared to be done with these records. Probably when a ship was paid off, the chronometers were consigned to Greenwich, and the records interred in the vaults of Somerset House. In France they acted differently. The performance while at sea of the chronometers of the imperial navy were carefully investigated, and from time to time the discussions were published in the volumes of *Rescherches Chronometriques*. These volumes were valuable alike to the mathematician, the geographer, the astronomer, and the horologist. It had always surprised him that nothing similar was attempted by our authorities. Now, as to turret clocks, notwithstanding all the science, experimental research, and exquisite mechanical finish brought to the construction of some celebrated clocks recently, by such men as Dent, Denison, Vulliamy, and others, still some few fractions of a second would go astray among the mechanism in the course of twenty-four hours. After the horologist had done his utmost the aid of the astronomer must be invoked, for this age of electric telegraphs and steam locomotion, and especially this busy nation, required the observance of correct mean solar time. Hence the task of keeping our clocks strictly correct devolved upon the astronomer. One would think he might exclaim "Time is out of joint, oh cursed spite that ever I was born to set it right." However he performed his duty to the admiration of every one. With the nicest method, the greatest fidelity, and utmost accuracy he consulted the celestial time-measurers, and by means of the electric wire flashed through the length and breadth of the land daily, if not hourly, signals of time, whereby our clocks were

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kept correct. And their Journal was always ready to recognise the sublime services of the astronomer. Thus they had advanced from the watch to the chronometer, from the clock to the electric time-signal, so that this nation might be said to be well posted up as to mean solar time, both afloat and ashore. Nevertheless they were not to "rest and be thankful." Perfection was not yet attained. Indeed theoretical perfection was an impracticable problem, like squaring the circle, the perpetual motion, or standing at the north pole. But there was no limit to the proximity to which they might approach perfection, therefore they would do well to strive for it. The object of the Institute then being a good one, let them all do their best to extend its utility. Lastly, as other speakers had intimated, there was one function which the Institute should never lose sight of, and that was, how to maintain, if he might not say reclaim, to the horologists of this country, that supremacy for excellence in watches, chronometers, and clocks which they have hitherto enjoyed.

The CHAIRMAN proposed "The Officers of the Institute," coupled with the names of the President, Mr. Valentine Knight and Mr. E. D. Johnson; and "The Trustees," coupled with the name of Mr. E. J. Thompson.

Mr. KNIGHT returned thanks. He was glad to meet the members of the Institute that day, and, if his health permitted, should be glad to be with them on many similar occasions.

Mr. E. D. JOHNSON, in acknowledging the compliment, remarked that, in his opinion, the secret as to why so many foreign watches were sold in this country had not been told. His impression of the matter was this, that the greatest enemy the British horologist possessed was the British shopkeeper, for many of those shopkeepers did not know how exactly to draw the line between profit and plunder.

Mr. E. J. THOMPSON said, he regretted much that his duties as one of the trustees were so light, and trusted that additions might be made to their museum, and library, so that the services of the trustees would be in continual request. It always gave him pleasure to attend their social gatherings, because they were at the same time edifying and pleasant. It was true there had been extreme views enunciated that evening; and there had also been calm disquisition. He believed that the value of the English and Swiss competition was not sufficiently understood. If they need not extravagantly laudate their foreign friends, they also must not despise their merits. He trusted that Horologists of all nations, would unite in propounding those just principles, and in augmenting that love of the art which had made it so useful to commerce, to science, and to civilization.

The CHAIRMAN gave "The Health of the Visitors" present; and called upon Mr. Torrens to return thanks.

In responding Mr. TORRENS said, it was a happy sign of the state of feeling prevalent in England that when those who pursued with scientific aptitude and skill the noblest of mechanical arts met at the festive board, they sought for their chairman one who being himself an eminent mechanician, was also a peer and a member of Her Majesty's household. Their president for the night had thus the singular fortune to be able to represent not only his own order, but the sympathy of the Crown for the people, and the respect of the people for the Crown, neither of which would ever cease, so long as they were mutual. His lordship had come from the palace to take part in that highly interesting occasion, and had shown his readiness to confer with the chronometer and watch makers' society on the condition and prospects of their admirable craft; and he might go back to the palace bearing the assurance that the Queen did not possess a more intelligent, industrious, loyal, and self-respectful class of subjects, within the circuit of her wide domain. For himself he would not enter into the discussion of any of the points regarding which they had heard so much lively and good humoured dispute. It was past contention that the Swiss made a great many cheap watches and we made not quite so many, but still a great many good ones. Not being initiated in all the mysteries of the art he would only say that in his opinion it must be a prodigiously big bag of bright buttons that would equal in worth a purse of true sovereigns. One thing however he fancied they all were agreed upon, namely that there were some hindrances to competition by English with foreign hands which ought to be removed; and which he ventured to say if proper means were used might speedily be swept from their path. One was the blundering practice of the Goldsmiths' Company in retaining their antiquated and absurd form of trade-mark. It was intolerable that a stupid old city superstition should weigh like a nightmare on the spirit of national industry. The Goldsmiths' Company might be very rich and very fat; and being at once intellectually indolent and morally irresponsible it might console itself with the poor excuse that it meant no harm while it continued to inflict the greatest possible amount of wanton injury upon a numerous and estimable class of men. Yet year after year the mischief went on; and the only explanation given by the Goldsmiths' Company was this,—"as it was in the beginning, is now, and ever shall be," tuttle and twaddle without end. Well he ventured to say that if no one else was found to grapple with this provoking and egregious mischief, he would undertake to bring it to an end in a very short space of time. There was a department of the government especially provided to overhaul such abuses. He had himself in earlier life served at the Board of Trade, and he had no hesitation in saying that if properly invoked, the power of that department would prove adequate to put an end to the clumsy injustice under which infliction the timepiece makers of the kingdom had too long passively lain.

The Company separated shortly after eleven o'clock.

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THE PRESENT STATE OF HOROLOGY IN ENGLAND.

Lord CAITHNESS, at a meeting of the Horological Institute, the other day, entered into some interesting details upon this subject, but the point of his speech consisted in a declaration that the art of clock-making is going out of England.

Statistics prove that France and America, are doing for us the work which we should do, and profit by, at home. From Switzerland, especially, the importation of watches, from France of ormolu clocks, and from America of brazen clocks has, of late years, enormously increased, and can this be without its effect upon our artisan classes?

We pay more than a million sterling a year to the foreign workman, who gives us an inferior article, instead of spending it, where it ought to be spent, in the chronometrical districts of Clerkenwell. Often has it been urged that an English lady is a benefactor of her countrymen if she persists in wearing English silk. In like manner, it is benevolence—and wisdom also—to buy only an English watch. Clerkenwell, in fact, is to the watchmaker what Spitalfields and Coventry are to the silk and ribbon weaver. It is the haunt of working jewellers; fifty per cent. of its population are employed in the glittering trade which has made in the district almost a noiseless progress from immemorial time. There the common talk is of movements, jewelling, diamond-cutting, lapidaries, pivot-holes, the gold and silver cases stamped at Goldsmiths' Hall, and of late particularly about the immense importation of foreign watches under favor of unreciprocated commercial treaties. The home manufacture is rapidly decaying. Seventy years ago nearly two hundred thousand watches were stamped at Goldsmiths' Hall, and although the duties afterwards imposed on their manufacture, sale, and even use, have since been repealed, the trade has never recovered, and competition from the Continent and from America has dealt it another disastrous blow. This we hear, not from Clerkenwell only. The complaint comes also from the movement-makers in Lancashire, and from all the hundred classes—literally a hundred—engaged with the motion-work, springs, and connecting mechanism; the escapements, cases, dials, enamels, glasses; the inlaying, painting, and figuring; the secret-springers, engine-turners, pendant-makers, makers of the watchkey, hand, index, and fusee; with stone preparers and other curious artificers.

The French, at one period of their industrial history, nearly equalled us in horology. The inventions of M. Breguet, were numerous and brilliant. His astronomical clocks, and watches, and marine timepieces, were improvements which not even the best of our manufacturers can affect to despise. But we have progressed beyond all that. For every good chronometer made in France two hundred of superior quality are made in England. French astronomers, no doubt, insist upon almost perfect manufacture; but their countrymen, as a rule, prefer the case to the work, the toy to the instrument, the trinket to the machine. And let us bear in mind the fact that when they manufacture for our market they imagine that in this respect we resemble themselves. With regard to Switzerland, its grand centre of the watch trade—grander than ever—is in London. Neuchatel and Geneva export nearly a million's sterling worth every year; and these "golden marks of human culture" add little to the plenty or content of our artisans. But why, as Lord Caithness asks, should the clock manufacture go out of England? We enjoy the most ample means of developing it, and, indeed, have long been celebrated in that capacity. The pendulum first became practical in the hands of Huygens and Hooke, eighteen years before the founding of Greenwich Observatory; Flamstead's giant pendulums, 13 feet long, required to have their machinery adjusted only once a year; and Graham and Bradley have never been surpassed.

But everybody can tell what is their universal social use. They regulate our social lives. Almost as the sun they decide our hour of rising and retiring to rest. They are our constant monitors. The gigantic railway organization of the kingdom is ruled beneath their influence. They are necessities in every household, and why not have them constructed for us at home instead of going to the markets abroad? We do not want German or Japanese productions, exhibiting varied landscapes, golden morns, birds clapping their wings, tortoises creeping from caves to point out the hour, or mice running to and fro with the time on their backs. We desire to have a steady clock in our house, and a trustworthy watch in our pocket, and if the Horological Institute can promote the manufacture of both in England, for the benefit of English artisans, may it flourish!—Abridged from the "*Standard*."

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., APRIL, 1865.

11, *Offord Road, N.*

Days of the Month.	Barom. reduced to 32° F. and the sea level.	Temperature in the Shade. At 9 a.m.	Highest in the previous 24 hours.	Lowest during the previous 24 hours.	Rainfall.	Wind. Direction.	Wind. Force (scale 0 to 12)	Weather. At 9 a.m.	Weather. During the next 24 hours.
	Inches.	°	°	°	Inch				
1	30·085	49	52	41	0·07	WNW	2	bc	bc
2	·091	40	53	36	—	ENE	3	m	f, bc
3	29 873	42·5	51	36	—	ESE	2	bm	c, b
4	30·242	40·5	53	38	—	E	1	m	m, bc
5	·274	51	55	40	—	W	4	o	mp
6	·340	52	55	47	0·08	SW	2	c	bc
7	·243	53·5	60	47	—	WSW	2	bc	bc, b
8	·168	47	59	44	—	SSW	1	m	b
9	·262	53 5	66	44	—	S	1	b	b
10	·277	55·5	69	47	—	SW	2	b	b
11	·313	50	69	42	—	E	1	b	b
12	·123	49	63	43	—	E	1	b	bc
13	29 993	47	61	43	—	ESE	1	m	bc
14	·988	55	64	47	—	W	3	c	r, om
15	30·168	47	57	44	0·15	E	3	o	o, b
16	·224	51	54	42	—	E	1	b	b, r
17	29·990	56	66	50	0·14	E	1	bc	o, p
18	·930	59	68	53	0·01	S	1	o	o
19	30·207	51	66	48	—	NE	1	o	o
20	·216	47·5	62	44	—	ENE	2	o	c, b
21	·190	50	65	44	—	NNE	2	b	b
22	·164	55	72	45	—	NE	2	b	b
23	·241	51	73	42	—	NE	2	b	b
24	·300	47	75	41	—	NNE	1	b	b
25	·274	45	70	38	—	NNE	1	b	b
26	·172	56	67	44	—	NW	1	b	b
27	·155	61	74	50	—	E	1	b	b
28	·025	54	77	47	—	NE	3	bc	bc
29	·118	48	69	41	—	E	5	bc	bc
30	·037	45	54	35	—	NE	4	b	bc
	30·156	50·3	63·3	43 4	0·45	N65E	0·6	—	Means.

On the evening of the 12th a heavy thunderstorm occurred in Yorkshire. The temperature of the 27th was unprecedentedly high for the season; and the weather, on the whole characterised by drought and heat, was very unlike that usually experienced in April.

A Fine Day:—A fine day has a bright sun, but the heat is not oppressive. The sky is clear and of a pale blue color, with a few light clouds floating high. The air is heavy, as shown by a high barometric column; and dry, as shown by its absorbing moisture; but to the feelings it is light, elastic and pleasant. The temperature is equal to, or slightly above, that due to the time of year. The motion of the air may amount to a gentle breeze or subside almost to calm. The electricity of the air is in a state of equilibrium, and there is no disturbance in the earth's magnetic forces.

EQUATION OF TIME TABLE

For JUNE, 1865.

Day of the Week.	Day of Mth.	At APPARENT NOON. Equation of Time to be *subtracted* from *added* to Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *added* to *subtracted* from Mean Time.
		m. s.	s.	m. s.
Thurs .	1	2 27·53	0·376	2 27·51
Fri	2	2 18·32	0·391	2 18·30
Sat	3	2 8·74	0·406	2 8·73
Sun ...	4	1 58·83	0·420	1 58·82
Mon ..	5	1 48·58	0·433	1 48·57
Tues...	6	1 38·03	0·446	1 38·02
Wed ..	7	1 27·18	0·458	1 27·17
Thurs .	8	1 16·03	0·469	1 16·02
Fri	9	1 4·62	0·480	1 4·61
Sat	10	0 52·97	0·490	0 52·96
Sun ...	11	0 41·09	0·499	0 41·08
Mon ..	12	0 28·99	0·508	0 28·98
Tues...	13	0 16·69	0·516	0 16·69
Wed ..	14	0 4·22	0·523	0 4·22
Thurs .	15	0 8·39	0·529	0 8·39
Fri	16	0 21·15	0·534	0 21·14
Sat	17	0 34·03	0·538	0 34·02
Sun ...	18	0 46·99	0·541	0 46·98
Mon ..	19	1 0·01	0·543	1 0·00
Tues...	20	1 13·07	0·544	1 13·07
Wed ..	21	1 26·16	0·544	1 26·15
Thurs .	22	1 39·23	0·543	1 39·21
Fri	23	1 52·25	0·541	1 52·23
Sat	24	2 5·19	0·537	2 5·17
Sun ...	25	2 18·03	0·532	2 18·01
Mon ..	26	2 30·73	0·526	2 30·71
Tues...	27	2 43·28	0·519	2 43·26
Wed ..	28	2 55·64	0·511	2 55·62
Thurs .	29	3 7·80	0·502	3 7·77
Fri	30	3 19·71	0·491	3 19·68

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N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 23rd of the month.

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LECTURE ON THE GREENWICH SYSTEM OF TIME SIGNALS.

By WILLIAM ELLIS, Esq., F.R.A.S., of the Royal Observatory, Greenwich.

(*Concluded from page* 114.)

Although, as will have been seen, an extensive system of time signals, distributing time from Greenwich in many directions, has been long in operation, London itself can scarcely be said to benefit as much by it as would be expected. Time sufficiently accurate for all practical purposes is well known, but facilities seem to be yet required for obtaining at any moment something more exact, and seeing how the public seconds' clock at Greenwich is referred to, such facilities would seem to be best given by the establishment in central positions in London of clocks, which shall show seconds, be continuously regulated by galvanic current, and open to public inspection. A clock so regulated, when once established, would require, in addition to the usual attention of winding, only occasional inspection to see that it did really represent the governing clock. Currents being omitted by the governing clock at certain definite times, if these currents are found, at the regulated clock, to be omitted at the same times, proof of exact coincidence is afforded; and any casual visitor may check for himself the accuracy of the clock as well as can the person who may have charge of it. The only clocks in London thus regulated by galvanic current are (so far as I am aware) the London Bridge switch clock, and that in Messrs. De La Rue's factory in Bunhill Row. The former is not directly accessible to the public, but to the latter Messrs. De La Rue have most considerately added a dial, exposed to public view, in order that the public may share with them the benefit of that established in the first instance for the use of the factory. Now the establishment of similar clocks in central positions in London would evidently be of great advantage to the public, general, nautical and horological. And it would surely be possible to extend in London a system which, in order to show its practicability, needs only reference to what has been done at Liverpool, Edinburgh and Glasgow.

In these places clocks are now regularly controlled by galvanic currents originating in the observatories of the respective places, and give great satisfaction. Mr. Hartnup, at Liverpool, first applied Mr. Jones's system to public clocks, and Professor C. P. Smyth at Edinburgh, as well as Professor Grant at Glasgow, also speak of it with unqualified praise. Mr. Hartnup has for many years controlled the turret clock of the Liverpool Town Hall by this method; its performance was previously indifferent, but now the first stroke on the bell at each hour indicates exact Greenwich mean time. A large clock in the Victoria tower, Liverpool, one having six dials, is similarly regulated, and the first stroke on the bell similarly indicates exact time. But Mr. Hartnup says that "of all the methods which have been adopted in Liverpool for the dissemination of accurate time, the seconds' clock, which is controlled from the Observatory, appears to be the most highly appreciated by the public." At Glasgow the system appears to be taken up with even greater spirit. Professor Grant writing in the present month (February 1865) says: "At present there are ten public clocks in Glasgow controlled electrically from this Observatory at an average distance of three miles from the controlling source. Operations are also in progress for placing under control five more clocks all of which will be available to the public." Of the ten clocks under control, three are turret clocks "adapted" as Professor Grant says "so as to strike at *the second*," one shows time to minutes, and six show time to seconds. The University, the Town Council, and the Exchange authorities are among those who have availed themselves of the clock controlling system, and the Clyde trustees have decided upon placing clocks upon both sides of the river in behalf of the shipping interest. Professor Grant adds "Our experience of the working of Jones's invention since it was first introduced here has been eminently satisfactory." To come now nearer home. Mr. W. De La Rue says of his clock, "I can speak, from my own personal experience, as to the practicability of transmitting time signals and controlling clocks

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by electric agency, for, in my own works, Mr. Walker, in conjunction with Mr. Jones, has, by the kind permission of the Astronomer Royal, placed a clock so perfectly under the control of the Greenwich clock, that, unless there is some derangement of the wires, it beats, for months consecutively, second for second with the clock at Greenwich; and in case of an occasional variation, a signal comes four seconds after every hour, and furnishes a means of correction." These extracts show that there is no question as to the simplicity and success of the plan.

Seeing how the establishment of public clocks has engaged the attention of the authorities in Liverpool and Glasgow, it might be imagined that the success which has attended their introduction in those places, would only require to be known in London, to induce the people of London to take advantage of the proximity which Greenwich affords to introduce similar systems, or rather to extend that which has been already commenced. For, considering that there is already in existence a wire which carries controlling currents from Greenwich into the heart of London, and from which it would be possible to regulate other clocks, great facilities are thus given for their introduction. London cannot less require that which has been found in other places so advantageous, and the attention of the different public authorities might well be turned to the subject with advantage, as they especially would be so well able to place such clocks on a proper and permanent footing. London does possess one signal (an audible signal) of great value and considerable accuracy. The first stroke of the hour on the bell of the Westminster clock is generally correct to about one second of time. But public clocks of an authoritative character, continuously regulated by galvanic current and showing seconds, to which all persons may, at any time, with confidence refer, are undoubtedly also required.

I have now terminated my account. In conclusion I may remark, that the Greenwich system, as here described, well illustrates the beneficial effects arising from the mutual co-operation of several parties for a common object, in which way that may often be done which cannot by any other means, be so well performed, and which might, but for such co-operation, remain altogether unattempted. Greenwich Observatory supplies signals as required to those who, possessing the means of communicating with distant parts of the country, are willing to forward the work of distribution, and it is this joint action alone which maintains in existence a system by which the country almost unconsciously benefits, one which, having its origin in the National Observatory, has thereby sufficient guarantee for that which is fundamental. I may add that, excepting (for the reason given) some portion of the Post Office system, the whole of the operations which have been described continue at the present time in full and vigorous action.

[At the termination of the lecture, Mr. Jones rose, and moved that the best thanks of the meeting be tendered to Mr. Ellis for the very complete, illustrative, and valuable exposition he had given them of the Greenwich system of Time Signals. An enthusiastic manifestation of approval greeted this motion.

Mr. E. D. Johnson proposed a similar vote of thanks to Professor Airey, who, he remarked, in presiding over his own work, under the peculiar circumstances which have been already explained, had made them greatly indebted to him. The meeting unanimously appreciated this kindness; after which the Astronomer Royal addressed the Members as follows.—*Editor.*]

The ASTRONOMER ROYAL said:—I will, with your permission, Gentlemen, take the present opportunity to refer to one or two points, partly of history, which it may be interesting to make known here, since if it were not for the opportunity which an occasion like this affords, the memory of such circumstances would possibly not be preserved. When the Time-ball at Greenwich was first erected, it was, as you are aware, dropped by hand. The error of a clock placed near to the ball trigger having been previously ascertained, suppose it to have been 1ˢ·4 fast, the assistant, a few seconds before 1ʰ placed his thumb on the trigger, and counting the seconds of the clock, he, at 1ˢ·4 after 1ʰ clock

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time, discharged the ball by sharply pressing down the trigger. Now, on showing this to my friend Mr. Babbage, a man gifted with a greater far-seeing faculty than most people are aware of, he used to say to me, "Why do you not make the clock discharge the ball mechanically?" And my answer always was, "Yes, but how am I to get the clock right." The problem was, having a clock wrong by 1ˢ·4 how is it quickly to be got right. And this was long a difficulty, and I spent a great deal of time in endeavouring to arrange some scheme to effect the desired object. I at length arranged the plan of using an auxiliary pendulum, to be employed in the manner which has been described to you, and this was very good. Afterwards however I adopted the magnet and fixed coil, accelerating or retarding the clock by passing a current, positive or negative as the case might require, through the fixed coil, and so attracting or repelling, as might be necessary, the magnet fixed to the pendulum, and this method answers perfectly. We should have been unable to effect the regulation of clocks without this gradual and delicate method of acting on the pendulum of our own clock. The actual correction is made from the computing room. Here having two clocks placed side by side, one, sidereal, worked by the transit clock, and one, mean solar, worked by the normal clock, the two are compared together; and the error of the sidereal clock being known from observed transits of stars, the error of the mean solar clock is found by calculation of the comparison of the two clocks; then, by the commutator, the proper current for correction of this error is put on the coil, for the necessary length of time; all these operations being done at Mr. Ellis's desk in the computing room. The normal clock being thus got right, this clock, by means of contact springs, closes a circuit at every hour, as has been described to you, and hourly signals having their origin with this clock pass from the Observatory in several directions, being further distributed by Mr. C. F. Varley of the Electric and International Telegraph Company, and Mr. C. V. Walker of the South Eastern Railway, Mr. Varley having provided a beautiful apparatus for the distribution of time throughout the country principally at 10ʰ A.M., every day. I can hardly say how the time signal system came to be first proposed, it was somehow, partly in conversation, partly in other ways, how, I cannot exactly say, but to Mr. C. V. Walker, Mr. Edwin Clark, Mr. Latimer Clark, and afterwards Mr. C. F. Varley, is the existence of the system mainly due. The Deal time ball was not proposed by me, though I have taken great pains to render it efficient. I have indeed always considered it a very proper duty of the National Observatory to promote by utilitarian aid the dissemination of a knowledge of accurate time which is now really a matter of very great importance. The practical result of the system will be acknowledged by all those who have travelled abroad. We can, on an English railway, always obtain correct time, but not so on a French or German railway, where the clocks are often found considerably in error.

I must just allude to Mr. Jones's system of regulating clocks by galvanic current, a most excellent plan, of which the people of some of our northern cities have seen the benefit, and have taken advantage. I must say that London is indeed very far behind in this matter. I may tell you that my friend Mr. W. De La Rue estimates the annual saving to his firm by having exact time and enforcing strict attendance on his work-people, at £300 (besides some saving of gas and coals not taken into account) which is an amount that would otherwise be entirely lost, and of this he is able to make a return to his work-people in the way of additional privileges as respects holidays. Think only of £300 per annum being thus saved in one establishment alone, and then consider what would be the saving in London, if all establishments, of similar magnitude, could save a like amount.

In the extension of the Greenwich system there is one project which I hope to see some day carried out. I allude to the exhibition of hourly time signals at the Start Point. I have prepared a complete scheme for this purpose, the signal by day being the drop of a ball or semaphore arm and the signal by night a flash of gunpowder. Some day a plan of this

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sort may be established, and its value for ships would be very great, since it would enable masters to obtain for their chronometers sea going rates which I need hardly tell you is a thing of great importance.

BRITISH HOROLOGICAL INSTITUTE.

REPORT OF THE COUNCIL FOR THE HALF YEAR, JUNE, 1865.

The return of the usual period at which the Council report to the Members the progress of events connected with the Institute for the past six months, gives an opportunity to the Council to express their own satisfaction with the results of the past half year, and to congratulate the Members on the advanced position of the Institute. The embarassment of debt which then hung on the proceedings, and limited the action of the Institute is removed. The old standing debts, due to the Printers, have been discharged, and beyond such small current liabilities, as can easily be met, the Council are able to report that the Institute is out of debt, with a tolerable amount of capital invested in property gradually becoming realized; certainly bearing a marketable value.

The rumour of debt burdening the Institute hindered the accession of members, and gave prudential reasons for those already members to withdraw, if not from subscription from active encouragement of the Institute; of course there are exceptions to this general proposition, since the Council have had to acknowledge, with respect, the generosity of certain members, who from special reasons, wishing to retire from active duties in the Institute, withheld their resolution to do so, while there were difficulties to be met. But the general law of human nature is not to be gainsaid, and the Council, under the revived condition of the Institute, take it as an encouragement to hope that members will again be coming in and swell the income of the Institute beyond any previous precedent; nor are their hopes without foundation; the weekly meetings of the Council during the past half year have been, generally, enlivened by the proposition of new members, so that the balance is considerably on the side of the Institute. The more authoritative position which the Institute now enjoys enabled them to obtain from the Society of Arts, the use of their large room for Mr. Ellis's lecture, and warranted the Astronomer Royal in taking the Chair on the occasion of one of the assemblies of the Institute. The new matter set before the Trade in the lecture, and in the carefully drawn report of the lecture with accompanying diagrams, published in the Journal, the Council feel is a reward sufficient for all the work of the Institute.

In opening out new fields for employment the general resources of the Trade are increased, and the highest form which benificence can assume is here attained; while the appropriation by the Trade of the practical application of those new discoveries in the law of forces, which belong to the present age, must give to its members generally great intellectual enjoyment, and advanced social position.

The lecture of Professor Tennant also was one, which the full attendance of members and evident satisfaction pervading the meeting, proved to be full of interest. The Professor will probably oblige the Council with diagrams illustrative of his subject, and in an early number it is hoped, that the report of the lecture may be published.

The importance of an acquaintance with the elementary nature of the substances employed in our art cannot be overrated, since the perfection of the finished piece is dependent on the judgment with which the material has been produced; and a larger range of knowledge among the yearly augmenting metals, may often suggest an use which else might be imperfectly reached.

A large amount of the Council's time has been occupied with the important question of the relation of the Goldsmiths' Hall marking to the prosperity of the Trade. As one result of their influence the Council point to a die reduced in dimensions, and thus an instalment in the direction in which they have pressed.

The courteous reception which the Council met with from the Home Secretary, when introduced by Sir Morton Peto, is a witness to the power which organization confers on a trade, and a guarantee that on any future necessity the Institute will be found the efficient instrument for securing public attention and redress.

The published correspondence between the Goldsmiths' Company and the Council, and that between the British Ambassador at Paris and the Council, will already have furnished members with the means of detecting the fallacies in the letter of the Goldsmiths' Company, on a question on which they ought to have been already well informed, much more when they had a specific opportunity of obtaining right knowledge; and will enable members to observe

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that not one of the allegations submitted to the Master and Wardens has been disproved. The matter now rests in the hands of the proper officers of the Government, and still remains under the notice of the Council.

The elaborate review of the art of Horology which the Earl of Caithness favored the Trade with, at the annual dinner, is an instance of the interest which is felt even in the highest circles of Society, towards an art, the gradual unfolding of which seems both an effect and cause of the progress of civilization, containing as it does, the applications to human use of the profoundest investigations into nature, with as large an accumulation of human contrivances as is presented in any department of industry, and must, if that which is known separately is known also collectively, raise the estimation of the members of the trade in the social scale, as soon as the range of acquirements, needful for an accomplished Watchmaker, becomes known among the public.

In answer to the challenge for essays on the lever escapement the Council received some unfinished treatises; and, after some discussion on the propriety of allowing extra time for the completion, it was judged, that in a matter which becomes a new starting point for the manufacture in this country, the pressure for a few months was comparatively unimportant, and that the original idea of the Subscribers to the fund would be best kept in view by extending the period of competition for another six months. The honorable position which the successful competitor will hold, as the highest authority in the Trade on this special subject, apart from the consequent pecuniary results, is so just an object of ambition to a noble spirit, that the Council believe that their extension of period will be adequately answered.

In the Journal it is proposed to classify the Trades of Members and publish the names under their appropriate heads; it is hoped that this arrangement will frequently become useful to members, as well as to others not connected with the Institute.

Reverting then rather to what has been done, than pointing to prospects in the future, the Council are yet ready to carry out still larger measures than have yet been undertaken. They ask the encouragement which steady subscriptions, and occasional contributions to the Journal, supply, not omitting the exertions among members towards inducing their friends to join; and if this be given, they doubt not ere another summer returns, that the watch-making art will be among the most honored of mercantile engagements, and that to be a member of the Horological Institute, will eventually be an equal token of worth with the guarantees furnished by other learned Societies.

THE WATCH MANUFACTURE.

That plain truth is often an unwelcome intruder was, I think, exemplified by the opening speech of the Chairman at the late annual dinner, whose remarks and figures went very far to shew that English *Horlogerie* is losing its prestige and its trade.

It is worth our while then carefully to consider whether these things are so; and if it be true that English skill and English watch and clock making are on the decline, to endeavour to discover the reasons for its decadence and the means of its revival.

The French School of Horology has ever been the most formidable of our competitors abroad. In their productions we readily discover and trace *the endeavour to excel*. It seems as if the theory of his art was never absent from the French workman's mind. This is abundantly illustrated in the old French verge watches, many specimens of which have excited my unqualified admiration. Their characterising features are seen in the pains taken to attain a minimum of friction and loss of power through the entire machine. So near indeed did these artists come to their ideal, and so true were their productions to abstract principles, that their works fell a prey to their extreme nicety, or rather to the excessive minuteness of finish, which left no margin whatever for the wear and tear to which they were especially liable.

I believe the French watch would have merited a very different kind of a reputation, had its escapement holes been jewelled instead of brass with steel endpieces. It was a short-lived fast-wearing machine incapable of repair, and its doom was fixed immediately it was handed across the counter to be worn by an ignoramus who would never suffer it to be touched while *it would go*; the consequences are obvious, and we cannot wonder that these watches should have soon become "a bye word", and special objects of disgust to English workmen.

But *experientia docet*, and we find the Frenchman working out a new line of thought. Hitherto he had copied the English artist both in the arrangement and the principles of his movement, while the details

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were as entirely French. Failing signally with the verge escapement, the 'horizontal' was gladly welcomed from its English inventors; and forthwith he recommenced the task of producing *a good watch*. At first he was no more successful with the 'eschappement à cylindre,' than with the 'vertical,' and for the same reasons, the radical evil of both being the want of jewel holes for the small rapid moving pivots of the escapement. Jewels were found to be a *sine qua non*, and from the day of their adoption the French and the Swiss watches have taken a very well deserved place in the market, not in Europe only, but largely in America and the Colonies. The modern Geneva watch, which is only an offspring of the French, has become an article of commerce in every market in the world. The Swiss watch has made its way chiefly by its cheapness, but not entirely so; if it be of a good average quality, it goes and keeps good time for many years, with little or no wear, and consequently it enjoys a tolerably good character with that class of wearers for whose use it is adapted (persons with a light occupation.) I can quite endorse Mr. V. Knight's opinion as regards a very large quantity of the cheap rubbish at present imported (mostly by Jews), but we need not lose temper over such facts, the more trash they send here the worse for the general repute of foreign watches, and the better for our home made ones. Nevertheless it would be foolish to pretend that the foreigner has not gained upon us greatly during the last twenty years, and although he sends out more abominations than ever were perpetrated in England, yet he turns out creditable work too, and promises to put us on our metal for a long time to come. As regards ourselves we do not so much need new inventions of escapements and the like, as we do improved means of producing the best possible workmanship on the best models; in fact better means of production. Mr. Denison justly observes, that "nothing is more requisite to impress on horological inventors than this, that nothing more complicated than what is now in use has the smallest chance of being adopted." I insert this remark because I am satisfied that whatever watch is to rise to a leading position must not only be substantial, but simple, and I have already pointed out in this Journal certain particulars in which, I submit, simplicity is attainable.

I candidly confess I have no hope for the revival of English horology except it be by the use of machinery, and let no one pooh! pooh! the possibility; it was once impossible to make carpets by machinery, but it is now done with greater beauty and precision than the hand loom ever attained to; it was once deemed impossible to make an Enfield rifle, to plane a piece of iron, or to polish a plate of glass by machinery, but now they are every day performances; and any one who doubts the capabilities of machinery to accomplish (say at a low estimate) sixty per cent. of the work in a clock or a watch, would do well to pay a visit to Mr. Gillott's pen manufactory, Birmingham; and then we may make pretty sure that if it is not done in England, it will in other countries.

It is perfectly vain for us to take a stand upon the achievements of fifty years ago, or to point to the works of our fore-fathers as the samples of English art, and I am disposed to think *any* living workman would be as likely to go in if asked to produce the fellow watch to one in the possession of the Rev. G. S. Wasey, (a magnificent old gold repeater by Tompion, apparently as good as ever, and weighing over six ounces) as an American would be if told to copy Mr. Knight's clock.

ROBERT HOPWOOD.

ON BAROMETERS WITH SCALES OF INCHES AND MILLIMETRES.

By L. CASELLA, Esq., F.R.A.S.

The attention of meteorologists having lately been directed to the graduation of barometers with double scales, of inches and millimètres, by Messrs. Packe, Mathews, and Tuckett, induced me as a manufacturer to give the subject my careful consideration. To Mr. Packe for originating the inquiry, as well as to Messrs. Mathews and Tuckett for their close investigation of it, I feel much indebted; but as the matter so put forward by these gentlemen does not seem as yet to be clearly understood, I beg to state a few facts which may be useful to many observers.

1st. Barometers in brass frames, upon which a scale of inches and a scale of millimètres are engraved, should at 30 inches read also 761·75 millimètres. Then the index- or scale-error of the instrument for the scale of inches having been determined, that for the scale of millimètres can be easily calculated; for, the two scales having always the same temperature common to both, 1 inch is equal to 25·3916 millimètres.

2nd. It has hitherto been the general practice to make 30 inches correspond with 762 millimètres. Barometers so graduated are, speaking in a strictly scientific sense, incorrect in one of the scales. If an English standard measure has been used for laying off the inches, the milli-

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mètres are not accurate; but if a French standard measure has been employed, the millimètres will be correct, while the inches are slightly inaccurate. The blame for this want of precision should rather be given to the standard-scale makers than to the opticians, since the latter are in the habit of using measures made by the former, which, it now appears, are incorrect. Order either in France or England, a standard brass scale of inches side by side with millimètres, and they make you 30 inches equal to 762 millimètres. The English maker will lay down true inches, the millimètres being incorrect; and it will be *vice versâ* with the French.

Doubtless both nations have been led into this error by the Conversion Tables, as given in Guyot's 'Meteorological and Physical Tables,' and in many other works, forgetting that that table is for the purpose of converting lengths of the one scale into equivalents of the other at their respective standard temperatures only, viz. 62° Fahr. for inches, and 32° Fahr. for millimètres. Supposing the inches on such a barometer to be correct, the millimètres of the scale will be to true millimètres in the ratio of 762 to 761·75; and supposing the millimètres correct, the inches of the scale will be to true inches as 30 is to 30·01.

3rd. Observers, by disregarding the temperature of the scales, frequently make mistakes in converting inches into millimètres. Some convert the reading of a barometer with a millimètre scale into inches by the table, before it is reduced to 0° centigrade by the French table for that purpose. The reduction should be made *before* the conversion. Thus, let the barometer read 772 at 4° centigrade. Here the reduction is 0·5 millimètre. Hence the reading at 0° centigrade would be 771·5, for which the Conversion Table gives 30·375 inches. Similarly to convert the indications of English barometers into the French values, each reading must be reduced to what it would be if the temperature of the mercury were 32° Fahr., and that of the brass 62° Fahr., by the tables for the purpose (such as Mr. Glaisher's), and then the equivalent value can be correctly got from the Conversion Table. Thus at a temperature of 40° Fahr., suppose

the barometer-reading to be ..	29.475 inches,
the reduction is	·030 inch;

so that the reduced reading is 29·445 inches. for which the Conversion Table gives 747·89 millimètres.—*Proceedings of the B. M. S., No.* 19.

BELL METAL.—Melt together, under powdered charcoal, 100 parts of pure copper with 20 parts of tin, and unite the two metals by frequently stirring the mass. Product very fine. Another method is to take of copper 3 parts, tin 1 part, as above. Some of the finest church bells in the world have this composition.—*English Mechanic.*

MEMOIR OF
URBAN JÜRGENSEN, *of Copenhagen,* 1776-1830.

URBAN JÜRGENSEN was born at Copenhagen on the 5th of August, 1776. His father was watch-maker to the Court, and his mother, whose maiden name was Brunn, (or Brown,) was daughter of a Government Tax-officer, at Antvorskov in Zealand. He got his first tuition at home, and was afterwards sent to the well known public school at Copenhagen, called "the school for Posterity," which had excellent teachers, and was also protected by several highly influential and intelligent gentlemen, who gave lectures on various topics, such as M. Edward Storm, K. L. Rahbek, both well known in Danish literature; the former took a peculiar interest in the subject of this memoir, and had advanced him so much, that he had finished the school when 15 years of age, in order to be taught his father's craft at home. Mechanical work was now the principal thing, but at the same time mathematics and the living languages were studied privately. When twenty-one years of age, he was sent by his father to Neufchatel, in Switzerland, where he remained eighteen months, and afterwards six months at Geneva, constantly occupied with mechanical and practical work, and as he had frequently sent his father samples of his works, he advised the son to proceed to some other place, where the mechanical craft might perhaps not be better but the theoretical rules more completely taught, and he desired him particularly to go to Paris and London, where the support afforded by Government, and the extent of the markets, had brought the most perfect theory and practice to bear on the art of making watches and chronometers of the first class. By good recommendations, by his cleverness and zeal in his duty, he was admitted to the houses of M. Brequet and M. Ferdinand Berthoud, whilst in Paris; he was in particular enriched by the former with invaluable information, and allowed to work under his immediate eye, and verbally instructed by him. After some months, however, he saw the necessity of going to England, in order to get fuller knowledge of the celebrated Longitude-Chronometers of the English masters. M. Ferdinand Berthoud had got a name, not only in France, but in all Europe, for his productions of that kind, but England had produced Longitude-Chronometers of greater perfection, and in

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greater number. The war at that time raging made it difficult to travel from one country to another, and it was a costly affair to travel to England. Young Urban Jürgensen had however, about that time, received two public stipends from Copenhagen: one from the State-fund called "ad usus publicos," of 500 dollars, Danish currency, for two years, another from "the Reiersen-fund," of 300 dollars, Danish currency, for the same period. He found besides in London valuable recommendations to the Danish, and to the Saxon Ministers, and both assisted him to procure useful acquaintancy; by Brequet and other Frenchmen, he was likewise highly recommended. M. Brequet was then highly esteemed by the English, and some of his productions, which he had entrusted to the hands of M. Urban Jürgensen, were disposed of at very high prices, and Mr. Arnold, a great authority, declared Brequet to be the greatest artist of his kind, at that time living in Europe. When he had attained the object of his voyage to London, M. Urban Jürgensen returned to Paris, where he again worked for a time, and noted down the new discoveries of his art; thence he returned to Geneva, where he got introduced to the learned and much esteemed Professor M. Pictet, Editor of the "Bibliotheque Britanique." Finally he passed by Neufchatel, where he had become engaged and was now married, and returned with his young wife to Copenhagen.

From his return to Denmark, towards the close of 1801, a new period commenced of M. Urban Jürgensen's life. He was offered a partnership with a very clever artist, M. Etienne Magnin, who had for some years enjoyed a royal stipend* to make longitude-chronometers for the use of ships. These chronometers were executed with much mechanical skill by M. Magnin, but from a deficient theory the rate was not perfectly regular; a remedy would no doubt have been found, if the partnership had been concluded, but it never took place, and young Urban Jürgensen became his father's partner and took charge of the whole establishment. His younger brother, Frederick Jürgensen, afterwards court watchmaker, became his first pupil. In 1804, the subject of this memoir published in Danish, at royal cost, a treatise in 4to., with 18 copper plates, "On the Art of Watchmaking," or "Rules for the exact Measurement of Time by Watches," of which a new and enlarged edition was published in French the following year, "Principes généraux de l'exacte mesure du temps par les horloges," all containing much that was new at the time about the rules for making correct watches. In the French edition a description was given of a new invention, of which more hereafter, viz., the "Metal-Thermometer." These works were received with much favor by the critics, as well in the "Learned Tidings of Copenhagen," No. 70, 1809, as in the "Bibliotheque Britanique," No. 295, in which M. Pictet said, that whilst M. Urban Jürgensen was at Geneva, his enlightened zeal, and the frankness with which he communicated new discoveries to fellow artists had been favourably noticed, whilst others might have preferred an exclusive use of them.

In the same year 1804, a treatise "On the best mode of making and hardening Watch Springs," a subject then so to say unknown in Denmark, was sent by M. Urban Jürgensen to the "Royal Society of Sciences at Copenhagen;" it was printed in the Society's Tracts, and the author was awarded its silver medal.

As to the Metal Thermometers, M. Urban Jürgensen, had already in 1801, began to make pocket thermometers of metal, in the form of watches, with the scale of Réaumur. The first specimen he sent to M. Pictet at Geneva, who showed it to his colleagues and gave a description of it in the "Bibliotheque Britanique." Until then, the so-called "Pyrometres," or "Metal Thermometers," had indicated that fixed metals expanded or contracted by the variation of heat; the movement had been increased by the application of a wheel and pinion on an axis with a hand, but these instruments did not indicate regularly the degree of heat, and their movement could not be brought to correspond with that of a regulated thermometer. In his Metal-Thermometer of 1801, M. Urban Jürgensen prevented the irregular movements of the wheel and pinion by introducing a very long and weak spiral spring, which was fully explained in chapter 17 of the treatise, and it followed exactly the thermometer of Réaumur. When several of these instruments had been finished and regulated, M. Urban Jürgensen learnt that by violent jerks, when used by persons riding on horseback or in carriages, the long spring was easily injured by its own weight, and the instrument became useless; he however introduced such improvements, that after some time his thermometers gained

* The royal stipend or bounty was in fact charged to the state treasury.

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full solidity and could last for a long series of years. When he had solved this problem, he sent one of these instruments to "The Royal Agricultural Society of Copenhagen," in 1805, to authenticate that he had executed it entirely on his own plan and ideas. The Society's Committee on Arts gave a full report thereon, and concluded by proposing "That whereas M. Urban Jürgensen's thermometer is amongst the most ingenious and for the physical sciences most interesting inventions laid before the Society, he should be awarded the Great Gold Medal of the Society, to shew their full approval and esteem," which was approved of by the Society, and the Gold Medal was delivered by the then Crown Prince (afterwards Frederick 6th), at a full meeting of the Society.

Unfortunately for M. Urban Jürgensen he had great difficulty in procuring skilful workmen, and had himself to execute many mechanical parts with his own hands, by which much time was lost, and he was in want of timesaving machinery, the localities were not good, and his health was impaired by constant sedentary work. He resolved therefore in 1807 to go with his wife and son to Neufchatel, where they remained two years and a half, and a great deal of machinery to be used thereafter was executed, and his collection of instruments became valuable. His health was improved and his renown established, and the King of Denmark was graciously pleased to decorate him with the Silver Cross of Dannebrog. Before his return he went again to Geneva in order to learn the art of perforating those costly stones which are used in chronometers and astronomical pendulum clocks, an art which had long been known in England, but kept secret, and had at last been brought to Geneva by a M. Mallet, whose two pupils were in 1809 exclusively employed in this art for other watchmakers. The watchmakers of Switzerland, England, and France (with the exception of M Louis Berthoud) did not personally study the art, but had the stones worked by those who executed this speciality, but M. Urban Jürgensen knowing the difficulties in this respect at Copenhagen, where he would be far from the great marts of this kind, was most anxious to acquire the art, and by persuasion and considerable outlay he was at last initiated as an adept in the occult art. Whilst receiving instruction and practice, he took full notice of the process and made drawings of the instruments and machinery, all of which he deposited in manuscript with his two sons, who have continued the art of their father. The art was then fully unknown in the Danish Monarchy, except perhaps to M. Kessels of Altona.

In October 1809, M. Urban Jürgensen left Neufchatel and took several workmen with him to Denmark in order not to be without assistance, till he could have instructed new pupils. His father was then 64 years old, but kept the establishment, which had gradually become of importance, notwithstanding many difficulties which were caused by the depreciation of the monetary system in Denmark at that time. The father died in 1811, his younger son Frederick Jürgensen was made Royal and Court Watch-maker, and our Urban Jürgensen took up the establishment on his own account. His works were much appreciated at home and by foreigners, and several hundred of his new thermometers found their way to America, to the East Indies, &c, and he had also produced chronometers, partly on Arnold's plan, partly on an original construction. In 1815 M. Urban Jürgensen had an honor conferred on him, which was hitherto unknown in Denmark to men of his speciality, in being made a member of "The Royal Society of Sciences." He got acquainted with the celebrated Danish Astronomer Schumacher, by whose advice he pushed on further in the art of the higher watch-making. The King of Denmark granted M. Urban Jürgensen a yearly stipend to induce him to give more care to the production of such exact timepieces as were required for the Astronomer, the Geographer and Navigators. In 1822 he was made superintendent of all chronometers belonging to the Royal Navy, and in 1824 he was decorated with the Gold Cross of Dannebrog. We will here name several treaties published by M. Urban Jürgensen, "On Isochronism by the Movement of the Pendulum," in the works of the Royal Society of Sciences, section for natural sciences and mathematics, vol. 1. In the "Astronomische Nachrichten" 1823-24 the following: First,—Remarques sur l'horlogerie exacte &c. Second.—Description de l'echappement libre à double roue, proposé dans le No 10 des Astronom. Nachrichten, with a plate. Third.—Reponse à une lettre de Earnshaw Fourth.—Remarques sur les chronomètres destinés à la determination des longitudes terrestres, and fifth.—In No 49 for 1825, a description of an improvement of the Compensation-Pendulum. In the "Annals of the Royal Society of Sciences, of Copenhagen," section for Natural Sciences and Astronomy, Vols. 2 & 3," Description of a new Metal-thermometer," with plates. "On

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the effect of the air on the Regulator of Astronomical and Longitude-Chronometers, containing results of observations on different pressures of the air, 1828."

Besides other works of art, M. Urban Jürgensen produced, from his establishment, during the twenty years he lived after making his first Chronometer, above fifty instruments of the highest branch of horological science. For comparison's sake we may mention, that M. Ferdinand Berthoud, with all the assistance to be had in such a place as Paris, and with a considerable and yearly support from his Government, did not produce more than two longitude chronometers yearly, M. Louis Berthoud produced five yearly, which were very highly paid for, and his Government subvention amounted to ten thousand francs yearly. Amongst the above were six astronomical pendulum-clocks, without external ornaments, but of great perfection; they have been distributed as follows: one to the University of Christiania, another to that of Copenhagen, one was placed in the valuable collection of Professor Schumacher, Astronomer Royal, at Altona, and another was presented by the King of Denmark to the Chief of the Imperial Austrian commission for terrestrial measurement, General Von Fallon. Amongst the chronometers two may be noticed, which were executed to Royal command, on a new and peculiar construction, very regular and the interior luxuriously finished. The King of Denmark presented one of them to the Circumnavigator, Baron Krusenstern, in Russia, and the other to General Nudge, of England. Various young men were from time to time educated in the art practised in this establishment, and have afterwards set up for themselves. M. Urban Jürgensen died on the 14th May, 1830, 53 years old. He was the first Dane, who with success had carried on the higher Watch-making; his perfection was the result not only of practice and talent, but also of a genius cultivated by science. He was deservedly appreciated, not only in his own country, but in other countries, and not a few of his works were sent abroad. We have mentioned several favorable notices from competent men, and we may add, that his colleague, M. Kessels, of Altona, has given a most fair and favorable report in the "Astronomische Nachrichten," No. 42 and 60, of one of his pendulums and a chronometer; and in the same Annals, vol. 6, will be found testimonies from General Fallon, and Professor Hansteen, of Norway, about the pendulums, and M. Schubert has given an account of the time-piece in possession of Baron Krusenstern.

His work "On the art of Watchmaking," (published in Danish 1804, in French 1805,) has been republished by his son Louis Urban Jürgensen, after the notes of his father made shortly before his death. This new, authentic, and considerably enlarged edition, was published in 1838 in French, and the Academy of Sciences of Paris gave a favorable report of it. It was likewise published in Danish in 1839, and further enlarged and published in German, in 1842, with an appendix, on the art of grinding and boring diamonds and such stones as are used in watchmaking. All these editions have long ago been sold out.

His two eldest sons, Louis Urban Jürgensen, and Jules Frederick Jürgensen, continue their father's establishment, which is well known in Copenhagen under the firm of "Urban Jürgensen & Sons"; enjoying a large and well earned reputation.

THERMO-ELECTRIC PILES.

Notwithstanding the efforts made by a great many philosophers and skilful constructors, the electro-magnetic motors hitherto have been unable to compete advantageously with steam engines or gas motors. The chief cause of their inferiority is in the employment of the piles necessary for putting them into action. These piles, in fact, are only apparatus producing force by the combustion of zinc, and this metal is evidently a combustible dearer than carbon. From the experiments of Messrs. Joule & Scoresby, an electro-magnetic motor produces a mean work of 2553 foot-pounds (339 kilogrammetres); a gramme of oil (15½ grains) would produce, when burnt, an amount of heat equivalent to 49688 foot-pounds (6866 kilogrammetres.)

Let us admit that a steam engine utilises only a tenth-part of the heat of combustion, it will yet give double the work of an electro-motor; and as zinc costs nearly 14 times as much as oil, we see that the work of the electro-motor would cost 28 times as much as that of the steam engine.

M. Bunsen appears then to have entered the right path for the improvement of electro-motors, when he sought to construct thermo-electric piles powerful enough to work these apparatus. In these piles, in fact, which are purely metallic, it is by establishing a difference of temperature between the junctions of the pieces of the metals which compose them, that a current is obtained; it is by burning carbon that they are put into action. The number for December, 1864, of the "Annales de Poggendorff," gives a description of a thermo-electric pile, constructed by the celebrated

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chemist of Heidelberg, the ten elements of which are sufficient to produce all the effects of a couple of Daniell's of 14 square centimetres (55 sq. in.) in surface.

But the employment of native sulphate of copper to form one of the elements of this pile, by its association with an alloy of zinc and antimony, might have been a drawback to the generalisation of its employment.

We may melt copper pyrites, and mould it into rods of convenient form, but it then loses the greater part of its electro-motive force.

We must therefore welcome, as a notable progress, the construction of a thermo-electric pile still more powerful, and composed solely of metallic alloys. This is due to M. Marcus, instrument maker, and has already gained for its author a prize of 2500 florins, awarded by the Imperial Academy of Vienna for giving up this useful invention to the public use. The positive alloy is formed of 10 parts copper, 6 zinc, and 6 nickel; the negative alloy, of 12 parts antimony, 5 zinc, and 1 bismuth.

The elements are screwed to each other; one face of the pile is plunged into cold water, the other heated to 1112° Fahrenheit, by gas lamps or a carbon furnace. A remarkable circumstance—the water takes very little heat when the circuit of the pile is closed, much more, when it is open. The electro-motive force of a single couple is one twenty-fifth of that of a Bunsen's zinc-carbon cell, and its resistance ·0157 inch of normal wire. Six couples are sufficient to decompose water. Thirty couples make an electro-magnet support a weight of 150 lbs. Lastly, 768 couples represent a Bunsen's pile of 30 cells, and consume daily 240 lbs. of carbon.

We may therefore hope, at an early period, to see the telegraph working by the aid of indestructible piles, fed by the combustion of gas or carbon; and perhaps electro-motors in serious competition with gas motors, at least for minor operations.—Translated by J. S. HARDING, Esq., from the "*Bulletin Internation de l'Observatoire Imperial de Paris.*"

ABRIDGEMENTS OF SPECIFICATIONS OF PATENTS

RELATING TO WATCHES, CLOCKS, AND OTHER TIME-KEEPERS.

A.D. 1855, May 25.—No. 1189.

JACCARD, AUGUSTE PAILLARD (*a communication*).—*This Invention did not proceed to the Great Seal.* From the Provisional Specification it appears that the invention "relates to a novel arrangement of parts for driving the central seconds' hand. The spindle of the seconds' hand receives its motion from the fourth wheel by means of a pressure spring that drives it by friction of contact. On the top of the arbor of the fourth wheel a spur-wheel is loosely mounted. The boss of this wheel is made hollow to receive a coiled spring, which is fixed to the arbor of the fourth wheel, and presses against the inner periphery of the boss; a cap, which covers the boss, carries the central spindle for the seconds' hand, and the continuous rotary motion which the fourth wheel is calculated to impart to the wheel with the hollow boss is converted in the usual way into a motion by pulsations. When a stop is put upon the rotation of the seconds' hand and its wheel, the spring in the hollow boss will yield, and, sliding round in the boss, permit of the continued action of the other parts of the watch."

[Printed, 3*d.*]

A. D. 1855, June 25.—No. 1452.

POOLE, MOSES (*a communication.*)—"An improvement in sculpturing surfaces of marble and stone." The invention consists in "rolling or rocking an engraved or embossed metallic surface in contact with a surface of marble or wood, sand or other suitable cutting material being interposed between the metallic surface and the wood or stone to be operated upon, whereby the latter is ground or cut away, and an exact counterpart of the metallic embossed surface is produced." The above may be employed to emboss the pillars of clocks.

[Printed, 6*d.*]

A.D. 1855, July 11.—No. 1554.

ADAMS, JOHN.—"Apparatus to indicate the time when persons commence and leave their work." A series of cells or chambers are caused to revolve by clockwork, and are thus brought successively under the end of a tube, connected with the box in which the cells are enclosed, so that a ticket being dropped down the tube and falling into one of the cells, will register the time when it is dropped in. In some cases, in place of making the chambers or cells to revolve, the patentee connects "the descending tube with the clockwork," and thus delivers the card or ticket into the cell.

[Printed, 6*d.*]

A.D. 1855, September 42.—No. 2042.

WEBSTER, HENRY.—The object of the invention is to give a means of readily detaching the escapement from the train of wheelwork in timekeepers. This is effected by the application of one or more moveable plate or plates to the pillar plate, the escapement movement being attached to the moveable parts.

[Printed, 5*d.*]

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., MAY, 1865.

11, *Offord Road, N.*

Days of the Month.	Barom. reduced to 32° F. and the sea level.	Temperature in the Shade. At 9 a.m.	Highest in the previous 24 hours.	Lowest during the previous 24 hours.	Rainfall.	Wind. Direction.	Force (scale 0 to 12)	Weather. At 9 a.m.	During the next 24 hours.
	Inches.	o	o	o	Inch				
1	29·996	48	54	35	—	E	2	c	c, p, b
2	30·003	58	59	47	0·07	SW	6	c	bc
3	29 932	61	64	48	—	SW	6	bc	c, p, o
4	·905	58	68	53	·03	SSW	4	o	p
5	·707	63·5	63	53	·20	S	3	o	p, b
6	·994	56·5	70	48	·02	SSW	3	c	b
7	30·040	56·5	67	44	—	E	3	o	rr, b
8	29·988	51	60	44	·40	NE	1	c	b, llttr
9	·658	56	71	49	·30	SW	3	o	bc, r
10	·538	48	69	47	·35	NE	1	r	r
11	·606	47	52	44	·73	NNE	1	r	cbp
12	·863	50	50	45	·14	W	3	o	cb
13	30·045	51	60	42	—	SW	4	c	b, p
14	29·958	51·5	63	48	·08	E	4	o	o
15	·698	52	59	49	·02	SE	1	r	bc
16	·873	52	58	41	·01	SW	4	c	c, o, b
17	·929	54·5	59	46	·01	WSW	6	o	ocbp
18	30·102	53	63	48	·01	SW	1	b	bc
19	·368	56	65	45	—	WSW	2	b	b
20	·407	60	69	50	—	CALM	0	b	b
21	·087	64	74	52	—	E	3	b	b, llttr
22	29·985	64	79	56	·34	W	1	b	b
23	30·025	67	76	54	—	E	1	bc	b, llttr
24	·091	57·5	75	50	·78	W	2	bc	bc
25	·155	59·5	67	48	—	SW	2	b	b
26	·059	63	71	49	—	WSW	1	b	b
27	29·920	63	75	55	—	WSW	1	b	b
28	·893	60	72	55	·04	WSW	7	c	b
29	·956	63	69	55	·06	SW	6	o	bq
30	·784	60·5	73	55	—	WSW	7	b	bc
31	·983	60	68	51	—	W	2	c	cb
	29·953	57	66	48 6	3·59	SW	1·8	—	Means.

May has been warm, with thunderstorms, and excess of rain. The mortality of London was below the average all the month.

"If the old sayings may be credited, alternate warmth, moisture, and breezes in the month of May give promise of an abundant harvest. Among the wise saws which have been handed down through many generations are the following:—A dry May denotes a poor year. The warmth of May makes the wealth of the year. May fresh and breezy makes the year plentiful. A rainy May is followed by a dry June. Fogs in March denote frost in May. Fine Rogation days denote fine crops."—*Paris corresdent to the "Times."*

EQUATION OF TIME TABLE

For JULY, 1865.

Day of the Week.	Day of Mth.	At APPARENT NOON. Equation of Time to be *added* to Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Sat....	1	3 31·37	0·480	3 31·34
Sun ...	2	3 42·76	0·468	3 42·73
Mon ..	3	3 53·86	0·455	3 53·83
Tues...	4	4 4·64	0·442	4 4·61
Wed ..	5	4 15·09	0·428	4 15·06
Thurs .	6	4 25·19	0·413	4 25·16
Fri....	7	4 34·93	0·398	4 34·90
Sat....	8	4 44·29	0·382	4 44·26
Sun ...	9	4 53·24	0·365	4 53·21
Mon ..	10	5 1·78	0·348	5 1·75
Tues...	11	5 9·91	0·330	5 9·88
Wed ..	12	5 17·60	0·312	5 17·57
Thurs .	13	5 24·85	0·293	5 24·82
Fri....	14	5 31·64	0·274	5 31·61
Sat....	15	5 37·95	0·254	5 37·93
Sun ...	16	5 43·79	0·234	5 43·77
Mon ..	17	5 49·15	0·213	5 49·13
Tues...	18	5 54·00	0·192	5 53·98
Wed ..	19	5 58·34	0·170	5 58·32
Thurs .	20	6 2·14	0·147	6 2·13
Fri....	21	6 5·40	0·124	6 5·39
Sat....	22	6 8·10	0·101	6 8·09
Sun ...	23	6 10·23	0·077	6 10·22
Mon ..	24	6 11·77	0·052	6 11·76
Tues...	25	6 12·71	0·027	6 12·71
Wed ..	26	6 13·07	0·002	6 13·07
Thurs .	27	6 12·82	0·024	6 12·82
Fri....	28	6 11·94	0·049	6 11·95
Sat....	29	6 10·45	0·075	6 10·46
Sun ...	30	6 8·34	0·101	6 8·35
Mon ..	31	6 5·62	0·127	6 5·63

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N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 23rd of the month.

London: Printed for THE BRITISH HOROLOGICAL INSTITUTE by MACDONALD & NEAL, Steam Printing Works, 61, St. John's Square, E.C.; and Published by KENT & Co., 51, Paternoster Row, E.C.

The Journal may also be had of Messrs. Edwd. & F. N. Spon, 16, Bucklesbury, E.C. and at the following Watch Tool warehouses:—Delolme's, Rathbone-place; Ehnhuus, 53 Frith-street, Soho-square; Muller, King-street, Soho-square; E. J. Thompson, 5 & 6, Percival-street, E.C.; and C. B. Johnson, Market-place, Prescot, Lancashire; and of all Booksellers in Town and Country.

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REPORT OF THE ASTRONOMER ROYAL, 1865.

The Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, for the past year is dated June 3rd. As usual it contains passages of interest to our readers which we here reproduce. It appears that railway projectors are still besieging Greenwich Park, and their pertinacity will probably succeed, it is to be feared. If so, the Astronomer Royal sees no escape from the evil effects of tremors upon the Instruments.

It is in contemplation to erect a fireproof Chronometer room. "The pecuniary value of Chronometers stored in the Observatory is sometimes perhaps as much as 8,000*l*. I do not see that this can be done in any other way than by retaining the present room (the room above the principal Computing Room), making fireproof floor and ceiling, and stripping the old pannelling from the walls."

"The Transit-clock is in good order. Occasionally it has been stopped a few seconds through the retention of its wheel-teeth by the galvanic springs. The Barrel-clock of the Chronograph required, in the last winter, some repairs in the pivot-bearings, the round holes having been worn into an elongated and irregular form."

"The Motor clock is in good order; and, since the abstraction of pendulum-contact-springs mentioned in the last report, preserves a steadier rate than formerly. The Visitors are aware that, for producing those very minute changes of rate for a small time which are required to correct the petty errors of indication that arise in the course of a day, there is fixed to the pendulum a small steel magnet, which swings over a galvanic coil, through which currents of either character can be sent, the coil then having the property of attracting or repelling the magnet, and thus accelerating or retarding the vibrations of the pendulum. We now avail ourselves of the presence of the same magnet to effect the larger adjustments of clock-rate without stopping the clock. A vertical piece of iron wire is fixed by friction in a piece of wood projecting from the back of the clock-case, so that the upper end of the magnet swings under the end of the wire; and by raising or lowering the wire, the clock-rate is less or more accelerated. The apparatus for home-use and for distribution of galvanic currents at definite times is in good order."

"The history of the Dip-Instrument during the year just elapsed is important. In discussing all the observations made since the introduction of the new Instrument, I found it totally impossible to infer from them the value of the zenith-point (or reading of the circle when the dipping-needle is vertical.) The instrument is adapted to needles of three different lengths (3, 6, 9, inches) and the difficulty was felt equally with all. It then appeared to me that we had been proceeding in a course philosophically wrong, in attempting to infer the value of a purely geometrical element from observations so foreign in their nature and so defective in their accuracy as magnetical dips, when an independent and accurate determination might with ease be obtained. I therefore directed Mr. Simms to construct a Zenith-Point-Needle of brass; with pivots similar to those of the dip-needles; and with three pairs of points corresponding to the three lengths of needles used; loaded at one end so as to take a position perfectly definite with respect to the direction of gravity; to be observed with the microscopes, and to be reversed, exactly as the dip-needles. I consider this small apparatus to be a valuable adjunct to the Dip-Instrument, as giving the means of deducing independently a separate result from every one of the observations made in the several positions of the needle.

"The Visitors will remember that, in many successive years, I have adverted with great anxiety to the difficulties which I have experienced in the determination of Magnetical Dips, and that in my last Report I expressed my inability to receive as certain the reputed accordance of dip-determinations obtained in other places. To this I was led partly by the irregularities of our dip-results, of which after the severest examination I could find no direct explanation; and by the difficulties which, as I knew, had troubled other observers: but mainly by

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finding that needles of different forms produced systematic differences in the magnitude of the discordances which were produced by simply raising and lowering the needles. In the course of the last autumn, the Committee of the Kew Observatory courteously acceded to my request that two of their dip-instruments should be placed for a time at the Royal Observatory, in order that Mr. Glaisher, in concert with Mr. Balfour Stewart (Director of the Kew Observatory), might make observations with them. The dips were found to be accordant to a degree which I never witnessed before. Without having yet strictly brought the results to numerical comparison, I have now no doubt that they do bear a consistency equal to or comparable to that which is claimed for them; and I recognize that I was misled by the reasons, strong as I still consider them to be, which I adduced in my last Report to the Visitors. It happened that Mr. Simms, by whom our instruments now in use were prepared, and who had personally witnessed our former difficulties, was present during some of these experiments. Our own instrument being placed in his hands (November 10 to 19) for another purpose, he spontaneously re-polished the apparently faultless agate-bearings. To my great astonishment, the inconsistencies of every kind have nearly or entirely vanished. On raising and lowering the needles, they return to the same readings, and the dips with the same needle appear generally consistent.

"No care had been spared to make our agate-edges perfect. Those of the old instrument were prepared by Mr. Robinson and were revised by Mr. Barrow. Those of the new instrument were made by Mr. Simms. In using the services of the three confessedly best artists of Britain, I thought myself secure as to the character of the workmanship which I should obtain; and indeed I know not what else could have been done.

"As the greatest enemy to success in instrumental constructions is secrecy on the manipulation adopted, I will here give all the information that has reached me on the methods actually employed. On a very close examination of Robinson's agates, Mr. Simms sees concavities, (which, as I believe, I also see myself) suggesting to him the idea that, after being shaped (perhaps by some inefficient process) with coarse emery, the surfaces were immediately polished with tin-oxide or other polishing powder carried by a cloth. Mr. Simms' first agate-edges, after being roughly shaped, were brought to form with coarse emery, then ground with fine emery, and then polished with rotten-stone-powder, all carried by the same leaden tool; the form of the tool admitted of cross-stroke, and it is believed that the only fault in the process was that the cross-stroke was used too freely. The same agate-edges were brought to their present state by the use successively of fine emery and tin-oxide, carried by a brass tool which nearly fitted the agates, and which scarcely permitted cross-strokes; and the strokes were almost entirely longitudinal.

"I am still unable to see how this change of treatment can account for the removal of the discordances formerly observed, and I regard these discordances as authentic facts of observation, the study of which may not improbably lead to important conclusions on the nature of magnetization, and the nature of pivot-bearing."

The mean Magnetic declination for 1864 is about 20°38′ w and the mean dip about 68°4′.

Chronometers, Communications of Time, Longitudes, &c.

"A short time since the number of Chronometers on hand exceeded 200. On May 10, the number is 175, thus distinguished:—Chronometers the property of Government, 110; Chronometers the property of chronometer-makers, on the annual competitive trial, 47; Chronometers on trial for purchase by the Government, the property of makers (to be taken in exchange for dilapidated Chronometers, or to be tried as deck-watches), or the property of Officers of the Royal Navy, 11; Chronometers on trial for the India Store Department, 7. There are also 2 clocks on trial, for the India Store Department. All Chronometers on trial are rated every day, by comparison with one of the clocks sympathetic with the Motor Clock; a portion of the Government Chronometers,

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far more than sufficient for probable wants of the service, are also so compared; the remainder are compared every week. Every Chronometer, whether on trial, or returned from a chronometer maker as repaired, is tried at least once in the heat of the Chronometer-oven, the temperature being usually limited to 90° Fahrenheit; and, guided by the results of very long experience, we have established it as a rule, that every trial in heat be continued through three weeks.

"The decision on the merits of Chronometers, tried for purchase or for classification in merit, rests with me: it is a troublesome and responsible work, but the principal part occurs only once a year. The repairs of Government Chronometers are managed entirely under the superintendence of the Observatory, and are a source of continual correspondence and trouble of various kinds.

"The system of sympathetic clocks of Mr. Shepherd's construction includes seven, of which the most worthy of attention are, the Motor Clock, the large Public Clock, the Clock for Chronometer-comparisons, and a small clock no bigger than a chronometer fixed in the computing-room. The same galvanic current gives motion to the train of wheels in each of these clocks: and as the contacts completing the galvanic circuit are made by one pendulum (below the Motor Clock), it is only necessary, for their regulation, to regulate that pendulum. This is effected in the computing-room, by means of a commutator affecting the current of a subsidiary battery, by which a current of either kind is sent through a coil, which is fixed to the case of the Motor Clock in such a position that a steel magnet carried by the pendulum swings just over it.

"There is another small sized clock in the computing room of a different construction, sympathetic with the Transit-Clock; and the comparison of the Transit-Clock with the Motor Mean Time Clock, for determination of the errors of the Motor Clock, is in fact effected by the comparison of their sympathetic representatives in the computing-room, where also is the commutator by which the corrective action above mentioned is applied to the pendulum of the Motor Clock, accelerating or retarding it as long as may be necessary to correct its error of indication.

"The same current from the Transit-Clock regulates a clock in the S.E. Equatoreal room (on Mr. R. L. Jones' principle), and drives a chronometer on the eye end of the S.E. Equatoreal telescope.

"The whole of this system is in good order, excepting the telescope-chronometer, which is not perfectly efficient. I am trying a new construction of regulating (not driving) a chronometer by galvanic current.

"A galvanic circuit passes through the face of the Motor Clock by a wire which is interrupted at two places, where junction is made at every 60 minutes and at every 60 seconds respectively. Thus an accurate current is sent every hour, discharging the detent of the Time-Signal-Ball (which however is used only at 1h. P.M.) and working a relay which sends hourly currents to the South Eastern Railway Station, London Bridge, the Electric and International Telegraph Company's Office, and the Office of the London District Telegraph. At the S. E. R. Station is a clock, the property of the Royal Observatory, and governed by a current at every second from the Royal Observatory; by the mechanism of this clock, the course of the hourly current is determined. At 1h. P.M. it is sent to Deal to drop the Time-Signal-Ball there; the establishment connected with that Time-Signal-Ball is now entirely subordinate to the Royal Observatory, and for that public Signal, but for no other, the Astronomer Royal is responsible. At other hours the current goes to different stations on the S.E. Railway, at the discretion of their Telegraph Superintendent, Charles V. Walker, Esq., F.R.S. The seconds current is made useful to private Offices in London. At the Office of the Electric and International Telegraph Company, the Superintendent, Cromwell F. Varley, Esq., has mounted very beautiful apparatus for distributing the signal over various lines of railway reaching almost to the extremities of Britain, and for firing signal guns at Newcastle and Shields. The currents sent at every hour to the Office of the London District Telegraph are made available to chronometer-makers.

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"Signals of a less public character are sent to the Clocks of the Post Office and to the Clock on the Westminster Palace, and for these the Astronomer Royal is responsible.

"In the instances of the Deal Signal Ball, the Post Office Clocks, and the Westminster Clock, the instruments automatically report their own state, which thus becomes immediately known to us.

"I am informed that the value of these public signals is rising very much in general estimation.

"The whole system is in a perfectly efficient state.

"This extensive arrangement is founded entirely on amicable agreements made by me with the different commercial companies, on the basis of mutual assistance; nominal payments being made, as royalties, for the use of the poles on which the wires are stretched, and for small repairs. The establishment of the wires for earth-currents is on a similar footing.

"I can hardly doubt that there will soon be movements in London, as in other great cities of our Empire, for more perfect regulation of Public Clocks, and for other exhibitions of Time Signals. The business of the Royal Observatory, in reference to such proposals, will consist mainly in the transmission of currents accurately at every hour, or every minute, or every second, to definite offices in London; and to this I shall be prepared to give all the attention which it can require.—G. B. AIRY."

BRITISH HOROLOGICAL INSTITUTE.

THE HALF-YEARLY MEETING.

THE half-yearly meeting of the members of the Horological Institute, took place on the evening ot the 22nd June, at the rooms of the Institute, 35, Northampton Square. The attendance, though not large, was better than usual, but the proceedings were of a more encouraging character than have fallen to the lot of the Institute for some time.

E. D. JOHNSON, Esq., F.R.A.S., was requested to preside, and in opening the proceedings he said that the Institute required the aid of steadfast members who would work in fair and foul weather, rather than the enthusiasm of the fluctuating class. No one was more active in promoting the objects of the Institute than he had been, he might say from its commencement, and he regretted that his health prevented him continuing his efforts. It was right that younger men should now step into the direction of affairs. He regretted that the nominations of officers had been entirely left to the Council. It showed either excess of confidence, or apathy, which, if persistent, must be fatal to the Institute. They well knew that he was desirous of its prosperity. As he had not been able to give much attention to affairs during the past six months, he might look upon results as an outsider, and be the better able to judge of its working. As to the Journal, its great defect was that it dabbled in horology to a very small extent. Its matter exhibited the miserable state of badness of horological pens. In the last year not more than one dozen articles had appeared that were really horological. The cause of this was in the great mistake of under estimating the value of men who have the literary talent. Men's genius makes them irritable, and having so few really capable writers, it was lamentable that those should withdraw on account of personal differences, and a disinclination to make concessions. The Institute could not do without the good men, and it should especially husband the few who used the pen. The Horological Institute was the only association left for the redemption of the trade, and the Journal was its only hold upon the public. Finally he must regret the great apathy evinced by members abstaining from the meetings. The election of officers they would find to be by default, but a real election was the thing desirable. He concluded by calling upon the Secretary to read the report (which will be found at page 124,) and financial statement, (see page 139.)

The CHAIRMAN moved the adoption of the report with much pleasure, because it seemed correct and on the whole a fair *resumè* of what had been effected.

J. JONES, Esq., as one of those who had worked would second the report for their approval. No doubt the nominations having to be made by the Council was damaging, and ought to be avoided if possible. It showed want of activity in the members, seemed egotistical in the Council, while in reality it was to it a burden. But it could not be otherwise unless the members exercise their privilege of nominating officers. The work had indeed been done by a few members of the Council during the past half

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year. There were reasons for and against diminishing the present number on the Council, namely twenty-eight, which however could not be done without an alteration of the laws, and they had not been able to get a meeting strong enough for that purpose. The Council endeavoured to carry forward with right spirit and good intentions the objects of the Institute. The Journal had had as much done for it, as its managers could effect. It was difficult to get purely practical horological matter, but it has been asked for in all likely directions, and a pressure of solicitation to write, discuss, correspond, and communicate had been applied and not without result. No doubt the Journal has suffered through the pique of some gentlemen, and it was to be attributed to their misfortune that so much horological information as might be desired had not been forthcoming. The whole of the matter in the Journal he maintained had horological interests and was not beyond reasonable limits. There was indeed no lack of matter during the last year. Mr. Ellis had introduced to them what he might term a new branch of horology, as his lecture was the introduction of new ideas into the trade. A new idea had no limit to its usefulness, it belonged to all the world, descends to every age, as it never dies out; its value had no parallel among all that was done among men. There had been a difference of opinion upon the subject of the Hall stamping. Nevertheless their proceedings had shown that the organization of men has a power and carries legitimate success wherever directed, if good suggestion, and good judgment are secured, so that the object may be applied for properly. The Essays sent in for award will probably produce good horological matter. Could they offer money doubtless they could purchase information. They could then say to the promising individual, "You have a good knowledge of isochronal springs, can you give us your information for £50?" With a few £5 notes they could do something more; but as it was they were doing, as he thought, remarkably well, for the *Horological Journal* was indeed the representative of the trade. The finance caused positive wonder. Their debt which a year ago was accumulating and amounted to £111 was now reduced to £27! This was encouraging, and members were joining, so that they might hope much better to support the credit of the trade. He urged them then to accept the Report, for they stood on firm ground, and in good relation with the trade generally. As an illustration, they went to the Goldsmiths' Company with allegations. The company sent to France for information, and then condemned them as having made mistakes. They were vigilant and addressed the British Ambassador at Paris. He returned correct information, for his lawyer not only went to the book but to the mint, and confirmed their statements.

The report was then unanimously approved.

The SECRETARY announced the names of the officers:

PRESIDENT.

VALENTINE KNIGHT, ESQ., J.P.

VICE-PRESIDENTS.

C. J. KLAFTENBERGER.
E. D. JOHNSON, F.R.A.S.
JNO. JONES, F.R.G.S.

TREASURER.

S. JACKSON, 66, Red Lion Street.

COUNCIL.

H. BICKLEY, 6, Half-moon Crescent, Barnsbury
G. BLACKIE, 24, Amwell-street
F. BROWNING, 20, Prebend-street, Islington
J. DIMIER, 39, Wilmington-square
J. EVANS, 89, Mount-street, Berkeley-square
D. GLASGOW, 20, Myddleton-square
W. HISLOP, F.R.A.S., 108, St. John-street-road
C. B. HOLLIDAY, 7, Upper Charles-street
S. HOLDSWORTH, 54, Spencer-street
V. KULLBERG, 12, Cloudesley-terrace, Liverpool-road
C. LANGE, 9, Salisbury-street, Strand
T. MERCER, 45, Spencer-street
JNO. T. MURRAY, 30, Cornhill
G. E. MYLNE, 22, Great Percy-street
H. PALMER, 13, Lower Charles-street
JAS. PITKETHLY, 15, Clerkenwell Green
G. PRICKETT, 5, Corporation-row
C. REEPE, 75, Myddleton-street
W. G. SCHOOF, 9, Lower Ashby-street
E. STORER, 46, Myddleton-square
R. STRACHAN, 11, Offord-road
A. STRAITON, 15, Little Knight Rider-street
W. THOMS, 36, Spencer-street
J. L. TILLING, 1, Elizabeth-terrace, Liverpool-road
W. TWITCHINGS, 43, King's-square
J. R. WARMAN, 49, Spencer-street
H. G. WEBB, 159, St. John-street-road
A. P. WALSH, 5, George-street, Euston-road.

The CHAIRMAN stated that the officers were duly elected. With great regret he had to inform them that their President, VALENTINE KNIGHT, Esq., was greatly afflicted, and suggested that they should pass a vote requesting the Council to express their thanks and sympathy to him and distinctly assure him how anxious they were for his restoration to health. They well knew him to be universally beloved, not only for his liberality which was only exceeded by the manner of bestowing it, but for his genial disposition and great urbanity. He trusted that their good wishes would be a solace to him in his affliction.

A resolution was passed unanimously requesting the Council to give expression to these sentiments in a letter to the President.

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The Chairman said, organization was the thing wanted by watchmakers. He had never liked the affair about the stamping, which was purely the case-maker's business. The change of standard some years ago from 18 carat gold to 9, 15 and 18, was a mistake only designed to benefit the swindler, for the respectable firms keep to 18 even now. However the movement was admirable as a proof of organisation. He did not think the scheme for essays on the Lever Escapement a wise one. The story was too long. What were thought new and original escapements were not so, as he could prove. The most astounding, as well as the best inventions, were mostly vivifications of old ideas or designs. Still he would do all he could always to assist the Institute, but they must keep their hopes small less they be disappointed. He would now submit a vote of thanks to the Treasurer, Mr. S. Jackson, who was in a position to demand their very best thanks for the care, trouble and responsibility of his honorary trust so faithfully and efficiently performed.

Mr. Evans seconded this vote, which the entire meeting confirmed.

Mr. Jackson knew the members always were ready to acknowledge the services of the officers, and was much obliged for their expression of satisfaction. He wished his duty was more responsible. Monotony diminished effort, fresh energy was wanted. He suggested that next year some of the office-bearers at least should insist on their resignations being received, and so arouse the energies of the members. A larger balance even would not be so useful as talent and genius. There were very few of them capable of embodying their knowledge and experience in such language and form as to render them acceptable to their fellow-men; and the Institute should encourage these few, and identify itself generally with progress. It might advantageously exert its influence in the Exhibition of Arts and Manufactures about to be opened in the locality.

Mr. Jones thought every one should do a little. He had done as much as he knew how to do to advance the watchmaking of Clerkenwell to what it ought to be. It was equal as an intellectual employment to civil-engineering, medicine, or the law. For the laws of nature which they applied, were as profound and required as much study as the laws of the land, or the rules of medicine. And yet you shall find a man versed in the planets, the motions of the moon, the forces of gravity, electricity, magnetism, mechanics, acquainted with the conic sections, and the geometry of wheelwork—not devoid even of an intimacy with mineralogy, and such a cyclopedic mind shall not have an atom of knowledge not available in horology. But he cannot be ranked in society as an equal with physicians and lawyers. This was an injustice to the art, the character of which the Institute tended to elevate.

Mr. Jackson moved a vote of thanks to the committees, especially the Journal Committee. This having been seconded and carried,

Mr. Strachan returned thanks, and said he rendered his services with pleasure, so long as they were in want of better. As editor of the Journal, he must say, it was a very onerous duty, which he should be delighted to deliver over to some one else, whenever they please. He, with the aid of the great ability upon the Committee did his best for them, and he was therefore surprised to hear the Journal condemned as wanting in horological interest. His opinion was that no previous volume of the Journal possessed more horological matter than that for the past year. (Assent.) Not being a watchmaker however he might not be altogether correct in his impression. However the remedy was with themselves. They should contribute more largely, for however indifferently composed, the committee would do all it could to render the communications presentable.

Mr. Jones proposed that Mr. Ellis be elected a honorary member, in consideration of the valuable exposition he had given them of the system of electric time-signals.

Mr. Mylne seconded, and the election was unanimous.

A vote of thanks was then tended to the Auditors, and Mr. Evans in reply said, he had done the duty on several occasions with pleasure, and he was glad to say he never knew the Institute to be in a more flourishing condition. Not seven out of every ten of his customers knew of the existence of the Institute, of which he was proud to be a member, as it tended to his success in business.

Messrs. Gunton and Holdstock were elected Auditors.

The Chairman moved a vote of thanks to the Secretary for the general good discharge of his duties, which was passed unanimously.

A vote of thanks to the Chairman, terminated the proceedings.—[Ed. H. J.]

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British Horological Institute.

Balance Sheet of Receipts and Expenditure, for the half-year ending December 17th, 1864.

Dr.	£	s.	d.
To Cash in hand of Treasurer, at last audit	7	5	10½
,, Ditto Secretary	1	8	3
,, Subscriptions and Donations	81	2	6
,, Cash received for Journals	9	15	8
,, Ditto received for Advertisements	26	5	4
,, Ditto do. for Sundries	3	18	6
,, Cash returned for Carriage on Portrait	0	1	2
,, Error in making out deficit Account of late Secretary to his Credit	1	5	5
	£131	2	8½
To Amount received as Donations to relieve the Debt for Printing the Journal	32	8	4
To Loan, to relieve ditto	10	0	0
	£42	8	4

Cr.	£	s.	d.
By Cash in hand, not accounted for by the late Secretary	1	8	3
,, Rent, Taxes, and Insurance	44	9	7
,, Salaries, Wages, and Commission	30	1	10
,, Paid on Account of Journal Expenses	10	12	7
,, House Expenses	11	15	7
,, Stationery, Stamps, and Account Books	6	17	5½
,, Printing, Engraving, and Advertising	5	5	3
,, Newspapers, Periodicals, &c.	4	4	2
,, Sundries	3	12	0
,, Petty Cash Balance, unpaid at commencement of the half-year	11	11	3½
	£129	18	0
By Cash in hands of Treasurer	0	4	2
,, Ditto in hands of Secretary	1	0	6½
	£131	2	8½
By Amount paid to Messrs. Tirebuck on Account	42	8	0
Cash in hand	0	0	4
	£42	8	4

We, the undersigned, have examined the above Account, together with the vouchers and find the same to be correct.

JOHN EVANS,
CHARLES BACON,
DENNIS GUNTON, } *Auditors.*

December 29th, 1864.

Balance Sheet of Receipts and Expenditure, for the half-year ending June 17th, 1865.

Dr.	£	s.	d.
To Cash in hands of Treasurer at last Audit	0	4	4
,, Ditto do. Secretary, ditto	1	0	6½
,, Subscriptions and Donations	121	12	0
,, Cash received for Journals	12	15	4
,, Ditto ditto, Advertisements	25	11	7
,, Ditto ditto, Sundries	24	7	2
	£185	10	11½

Cr.	£	s.	d.
By Rent and Taxes	19	18	4
,, Salaries, Wages, and Commission	36	13	9
,, Journal Expenses	30	5	0
,, Messrs. Macdonald & Co., old account	9	5	0
,, Ditto do. miscellaneous	5	13	6
,, Messrs. Maclure & Co.	2	7	3
,, Messrs. Tirebuck's balance	18	2	11
,, House Expenses	7	9	10
,, Stationery, Stamps, and Account Books	8	14	7
,, Printing and Advertising	2	0	0
,, Newspapers, Periodicals, &c.	5	3	2
,, Sundries	3	11	7
,, Dinner Bill and Expenses	33	7	6
,, Treasurer's balance	2	5	10
,, Secretary's ditto	0	12	8½
	£185	10	11½

We have examined the above Accounts, together with the vouchers, and found the same to be correct.

Signed JOHN EVANS,
CHARLES BACON,
DENNIS GUNTON, } *Auditors.*

The New Beetle Jewellery.—Large numbers of West India beetles are now imported into France for the Parisian beetle jewellers. East India beetles are also in request. In Edinburgh and Birmingham there is a great quantity of beetle jewellery manufactured. The beetles selected are those with compact and dark bodies. The South American beetles used are a dead green colour, and they have the appearance of being ornamented in the arabesque style. When placed in breast pins gold antennæ and diamond eyes are added. Sir Emerson Tennent has presented Mr. Thomas, a Southampton beetle jeweller, who is going to exhibit in the Paris exhibition, with some specimens of the coleopters of Ceylon, described in Sir Emerson's work on that island. The elytra of these are like burnished emeralds, and the thorax like shining plate armour. Mr. Thomas is exhibiting brooches adorned with gold casts of the ancient fossil trilobite. The regularly articulated frame of these creatures, and the curious attitudes in which they perished, adapt them for the goldsmith's art. The tribolite existed through many geologic ages. It is found in the Cambrian and is traced up to the carboniferous periods. Its existing analogue is the woodlouse. Primeval lice and modern beetles now furnish ornaments for dress.

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METEOROLOGICAL OBSERVATIONS,

Taken at 9 A.M., JUNE, 1865.

11, *Offord Road, N.*

Days of the Month.	Barom. reduced to 32° F. and the sea level.	Temperature in the Shade. At 9 a.m.	Highest in the previous 24 hours.	Lowest during the previous 24 hours.	Rainfall.	Wind. Direction.	Force (scale 0 to 7)	Weather. At 9 a.m.	During the next 24 hours.
	Inches.	°	°	°	Inch.				
1	29·912	63	68	50	—	E	4	c	bc, r
2	·658	58	67	53	0·90	WSW	6	o	r
3	·948	58·5	60	52	·20	SW	3	o	bc
4	30·248	62	68	53	—	SW	2	b	b
5	·361	61	72	52	—	W	4	b	b
6	·349	69·5	76	60	—	CALM	0	b	b
7	·380	63	77	59	—	N	1	b	b
8	·534	59	74	49	—	E	2	b	b
9	·406	69	75	56	—	WSW	2	b	b
10	·217	67	82	56	—	W	1	c	b
11	·222	58	73	50	—	SE	2	c	cb
12	·471	52	63	44	—	N	4	b	b
13	·465	60	68	49	—	W	1	bc	b
14	·402	64	76	54	—	SSE	2	mc	b
15	·432	59	77	49	—	NE	1	b	bc
16	·441	59·5	72	52	—	NE	5	c	bc
17	·427	59 5	68	50	—	N	3	c	bc
18	·331	54	69	50	—	NE	3	o	o
19	·382	53	59	50	—	NE	3	o	cb
20	·391	59	74	48	—	E	2	b	b
21	·380	64	79	51	—	E	1	b	b
22	·376	59	81	54	—	E	1	b	b
23	·239	70 5	79	56	—	ESE	1	b	b
24	·190	62	84	59	—	N	3	b	b
25	·164	62	71	55	—	WNW	3	cb	bc
26	·104	62	75	54	—	WSW	2	o	cb
27	·230	66	70	52	—	N	3	o	o
28	·123	64	71	53	—	E	2	o	o
29	29·695	66	73	54	—	E	1	o	r
30	·312	58	69	55	0·51	ENE	3	o	
	30·226	61·4	72·3	52 6	1·61	N 23° E	0·5	—	Means.

June has been a month of very fine weather. The temperature was from 2 to 3 degrees above the average, while the barometric pressure was high and the prevalent winds north-easterly. Although rain fell only on 3 days, the amount is greater than that in June 1864, when rain fell on 11 days.

ERRATA

In the current Volume, (Vol. VII.) of the HOROLOGICAL JOURNAL.

Page 97, column 2, line 15 from bottom, *for* rests against, *read* is attached to.

Page 97, column 2, line 11 from bottom, *for* annexed, *read* following.

Page 113, column 2, line 14 from bottom, *for* begin, *read* being.

Page 122, column 2, line 30, *for* Airey, *read* Airy.

EQUATION OF TIME TABLE

For AUGUST, 1865.

Day of the Week.	Day of Mth.	At APPARENT NOON. Equation of Time to be *added* to Apparent Time.	Difference for One Hour.	At MEAN NOON. Equation of Time to be *subtracted* from Mean Time.
		m. s.	s.	m. s.
Tues...	1	6 2·27	0·152	6 2·29
Wed ..	2	5 58·31	0·178	5 58·33
Thurs .	3	5 53·73	0·204	5 53·75
Fri	4	5 48·53	0·230	5 48·55
Sat	5	5 42·72	0·255	5 42·74
Sun ...	6	5 36·29	0·280	5 36·32
Mon ..	7	5 29·28	0·304	5 29·31
Tues...	8	5 21·69	0·329	5 21·72
Wed ..	9	5 13·51	0·353	5 13·54
Thurs .	10	5 4·77	0·376	5 4·80
Fri	11	4 55·48	0·399	4 55·50
Sat	12	4 45·63	0·421	4 45·66
Sun ...	13	4 35·26	0·443	4 35·29
Mon ..	14	4 24·36	0·465	4 24·39
Tues...	15	4 12·95	0·486	4 12·98
Wed ..	16	4 1·05	0·507	4 1·08
Thurs .	17	3 48·64	0·527	3 48·67
Fri	18	3 35·74	0·548	3 35·77
Sat	19	3 22·34	0·568	3 22·37
Sun ...	20	3 8·47	0·588	3 8·50
Mon ..	21	2 54·12	0·607	2 54·15
Tues...	22	2 39·32	0·626	2 39·35
Wed ..	23	2 24·07	0·645	2 24·10
Thurs .	24	2 8·38	0·663	2 8·40
Fri	25	1 52·26	0·680	1 52·28
Sat	26	1 35·73	0·697	1 35·75
Sun ...	27	1 18·80	0·713	1 18·82
Mon ..	28	1 1·49	0·729	1 1·50
Tues...	29	0 43·80	0·744	0 43·81
Wed ..	30	0 25·75	0·759	0 25·75
Thurs .	31	0 7·36	0·773	0 7·36

ADVERTISEMENTS.

	s.	d.
Business Advertisements, 4 lines and under...	1	6
Each additional line	0	4
Situations and Apprentices, 2 lines	0	6
Each additional line.....	0	3

Displayed Advertisements charged for according to the space occupied.

Five per cent. discount on the above charges if three or more insertions are paid for in advance; and ten per cent. on six or more insertions.

N.B.—All Advertisements to be inserted in the Journal must be forwarded to the Secretary, at the Office, 35, Northampton Square, E.C., before the 23rd of the month.

London: Printed for THE BRITISH HOROLOGICAL INSTITUTE by MACDONALD & NEAL, Steam Printing Works, 61, St. John's Square, E.C.; and Published by KENT & Co., 51, Paternoster Row, E.C.

The Journal may also be had of Messrs. Edwd. & F. N. Spon, 16, Bucklesbury, E.C. and at the following Watch tool warehouses:—Delolme's, Rathbone-place; Ehnhuus, 53 Frith-street, Soho-square; Muller, King-street, Soho-square; E. J. Thompson, 5 & 6, Percival-street, E.C.; and C. B. Johnson, Market-place, Prescot, Lancashire; and of all Booksellers in Town and Country.

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END OF VOLUME VII.

Macdonald & Neal, Steam Printing Works, 61, St. John's Square. E.C.

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LIST OF MEMBERS OF THE BRITISH HOROLOGICAL INSTITUTE.*

Name.	Residence.	Occupation.
Adams, F. B.	81, Cannon-street West, City,	
Adams, Thos.	15, Cannon-street, City,	Chronometer & Watch-manufacturer.
Adkins, H. B.	123, St. John's-street-rd., Clerkenwell,	Watch-maker.
Airy, G. B., Professor	Royal Observatory, Greenwich,	Astronomer Royal, &c., &c., &c.
Armstrong, T.	88, Deans Gate, Manchester,	Manuf. of Weight and Spring Clocks.
Austen, Jno.	93, High-street, St. John's-wood,	Watch and Clock maker.
Axmann, O.	129, St. John's-street-rd., Clerkenwell,	Watch-maker.
Bacon, C.	37, Gerrard-street, Islington,	Lever and Duplex Escapement-maker.
Bailey, Jno.	Albion-works, Salford, Manchester,	Turret Clock-maker.
Bailey, W.	8, Wakeling-terrace, Barnsbury-grove,	Examiner.
Ball, R.	31, Sudeley-street, City road,	Case-maker.
Band, Henry	81, Craven-street, Coventry,	Watch-finisher and Examiner.
Band, T.	Summerland Butts, Coventry	Watch-finisher.
Barron, Joseph	Haughton-street, Prescot, Lancashire,	Balance-maker.
Barter, G.	23, Packington-street, Islington,	Watch-manufacturer.
Baynes, F. R.	15, Craven-street, Strand,	Watch-maker.
Benfield, Thos.	30, Northampton-square, Clerkenwell,	Engine Turner.
Bennett, Jno., F.R.A.S.	64 & 65, Cheapside, City,	Chronometer and Watch-maker.
Bennett, J. W.	21, Fore-street, Kingsbridge, Devon,	Chronometer and Watch-maker.
Benson, J. W.	33 & 34, Ludgate-hill, City,	Chronometer and Watch-manufacturer.
Bickley, H.	6, Half Moon-crescent, Barnsbury-road,	Watch and Chronometer-finisher.
Bishopp, E. J.	Moorgate-street, City,	Watch-maker.
Bjorkdahl, C. F.	12, Cloudesley-terrace, Liverpool-road,	Watch-maker.
Blackie, G.	24, Amwell-street, Clerkenwell,	Chronometer-manufacturer.
Botsford	8, Exchange-street, Manchester,	
Boulton, G.	21A, Northampton-square, Clerkenwell,	Solicitor.
Boulton, J.	Ditto ditto,	Solicitor.
Bowen, D.	Alfreton (Market-place) Derbyshire,	Watch-maker and Jeweller.
Box, W. B.	21, Upper-Charles-st., Northampton-sq.	Watch-manufacturer.
Brequet, Mons.	16, Rue de la Paix, Paris,	Watch and Chronometer-maker
Brocking,	Adolph Platz, Hamburg,	Chronometer-maker.
Brocot, Mons.	6, Rue du Parc Royal, Paris,	Clock-manufacturer.
Brooks, S. A.	10, Northampton-square, Clerkenwell,	Chronometer and Watch-jeweller.
Brown, Ed.	16, Rue de la Paix, Paris,	Watch-maker.
Browning, F.	20, Prebend-street, Islington,	Watch-finisher.
Bryson, Alexander,	Prince's-street, Edinburgh,	Clock-maker to the Queen.
Butler, Wm.	St. Helens, Lancashire,	Watch-maker.
Carley, G.	30, Ely-place, Holborn,	Watch-manufacturer.
Chatfield, E.	Longton, Staffordshire,	Watch-manufacturer.
Clarke, Dr.	Finmere House, Finmere, Oxon.	
Clarke, J. C.	18, President-street, East, Clerkenwell,	Enameller.
Clarke & Sons,	173, Goswell-road, Clerkenwell,	Watch-manufacturers.
Clarke, Wm.	Ditto ditto,	Ditto Ditto
Clerke, F. W.	168, Fenchurch-street, City,	Chronometer-maker.
Cockerell, G. J.	Cornhill, City,	Coal-merchant.
Cox & Co.,	Christchurch, Hants,	Fuzee-chain-makers.
Crisp, W. B.	81, St. John's-street-road, Clerkenwell,	Chronometer and Watch-maker.
Curzon, C.	Stamford-cot., Page Green, Tottenham,	
Curryer, A.	24, Offord-road, Barnsbury,	Lever Escapement-maker.
Dallas, Alexander,	77, Church-street, Inverness,	Watch-maker.
Davis, D.	Green's-end, Woolwich,	Ditto.
Delletrez, J. B.	12A, Margaret-street, Regent-street,	Clock-manufacturer.
Dempster, W.	130, St. John's-street-road,	
Dent, F. M.	Cockspur-street, Charing Cross,	Chronometer and Watch-maker.
Desprez, C.	30, Park-road, Bristol,	Watch and Clock-maker.
Dimier, J.	39, Wilmington-square, Clerkenwell,	Watch-case Engraver.
Dunn, C.	3, Upper Gloucester-street, Clerkenwell,	Watch-manufacturer.
Edwards, J. T.	High-street, Dudley,	Watch maker.
Ehnhuns, H.	53, Frith-street, Soho,	Watch-makers' material dealer.
Ehrhardt,	26, Augusta-street, Birmingham,	
Ellis, Wm. Esq., F.R.A.S.	Royal Observatory, Greenwich,	Assistant to the Astronomer Royal.
Elston & Sons,	22, Myddleton-street, Clerkenwell,	Engine-turners and Dial-finishers.
Evans, John	89, Mount-street Grosvenor-square,	Chronometer, Watch, & Clock-manufact
Falconer, G.	Hong Kong, China,	Watch-maker.
Fellows & Co.	New York, U. S. America,	Watch-makers.
Fisher, Henry	10, Windmhule-st., Mariahilfer, Kempster Vienna, Austria,	Watch-maker.
Flint, Charles	81, Craven-street, Coventry,	Watch-manufacturer.
Foster, Bros.	Market Avenue, Ashton-under-Line,	
French, J.	16, Northampton-square, Clerkenwell,	Chronometer and Watch-manufacturer.
Frisch, F.	24, Church-street, Liverpool,	Watch-maker.

* To be bound at the end of Volume VII.

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Name.	Residence.	Occupation.
Frodsham, C. F.R.A.S.,	84, Strand, London,	Chro. Watch,& Clk-maker to the Queen.
Frodsham, C. M.	84. Strand, London,	Chronometer and Watch-maker.
Frodsham, G.	4, Change-alley, Cornhill, City.	Chronometer and Watch-maker.
Ganeval & Callard	27, Alfred-street, Islington,	Watch-pendulum spring & wire-manufa.
Ganney, H.	72, Ossulton-street. St. Pancras,	Watch-maker.
Gardner, W. H.	36, Union-place, Butts, Coventry.	Watch-manufacturer.
Gartner, C.	13, Lower Ashby-street, Clerkenwell,	Chronometer and Watch manufacturer.
Gartner, H.	Old Court House-st., Calcutta,	Watch-maker.
Gartner, W.	107, Bourke-st., East Melbourne,	Watch-maker.
Gath, F.	Small-street, Bristol,	Watch-maker.
Gibson, James	1, Crown-st ,Hebden Bridge. Manchester	Clock, and clock tool manufacturer.
Gill, D. J.	48. Skene-terrace, Aberdeen,	Watch-maker.
Gillett & Bland	Horology works, Croydon, Surrey,	Clock-manufacturers.
Glasgow, David,	20, Myddleton-square, Clerkenwell,	Chronometer and Watch-manufacturer.
Gleave, R.	4, Trafalgar-place, Dalston,	
Glover, J.	Widness, near Warrington,	Movement-maker.
Godfrey, W.	11, Green-terrace,	Chronometer Escapement-maker.
Gooding, Wm.	at Mr. Benson's, Ludgate-hill,	Watch repairer.
Gordon, Theodore	26, Great James-street, Bedford-row,	
Goulding, F.	Plymouth,	Watch-maker.
Gowland, James	52, London-wall, City,	Watch-maker.
Graham, Benj.	Kirkgate, Wakefield,	
Grant, G.	Cheshunt, Herts,	
Grandjean, Henri	Locle, Switzerland,	Watch-manufacturer.
Grimshaw, F.	35, Goswell-road, Clerkenwell,	Watchmakers' material dealer.
Grossmann, Moritz,	Glashutte, Saxony,	Watch-maker.
Guillaume, C.	Switzerland,	Watch-manufacturer.
Gunton, Dennis	3, Skinner-street, Clerkenwell,	Engine-turner and Dial Finisher.
Hargermark, C.	Amoy, China,	Watch-maker.
Hammersley, J.	54, Spencer-street, Clerkenwell,	Escapement-maker.
Hancock, Luke	63, City road,	Watch-maker.
Hanman, J.	Westgate-street, Gloucester,	Watch-maker.
Hartnup, J., F.R.A.S.	Liverpool Observatory,	Astronomer.
Harvey, James	Albert-terrace, Barnsbury-road,	Pocket Chronometer Finisher.
Haselden, G.	18, King-street, Clerkenwell,	Gold Chain manufacturer.
Haswell, R.	49, Spencer-street, Clerkenwell,	Watch tool dealers.
Hawkins, C. H.	1, Percival-street, Clerkenwell,	Watch-case Glider.
Heward, J.	24, Amwell-street, ditto,	Escapement-maker.
Hewitt, F.	11, Green-terrace, ditto,	Chronometer-maker.
Heyes, Thomas	92, Downham-road, Kingsland,	Chronometer-maker.
Hislop, Wm., F.R.A.S.	108, St. John's-street-rd., Clerkenwell,	Watch and Chronometer-maker.
Hoddell & Co.	Chapel-fields, Coventry,	Watch-manufacturers.
Hoffmann, F.	32, Wilmington-square, Clerkenwell,	Machinist and Model-maker.
Holdstock, T. W.	25, Percival-street, Clerkenwell,	Watch pallet-maker.
Holdsworth, S.	54, Spencer-street, Clerkenwell,	Manufacturer of Chronometer pallets, Chronometer, and Watch Jewels, and dealer in precious stones.
Holliday, C. B.	7, Upper Charles-st., Northampton-sq.,	Gold case-maker.
Hopwood, R.	Bridgenorth, Shropshire,	Watch-maker and Goldsmith.
Horner, Charles	Hebden-bridge, Yorkshire,	
Hunt, George	16, Chad-rd., Edgbaston, Birmingham	
Hutton, D.	Castle-street, Liverpool,	
Hutton, John	10. Mark-lane, City,	Chronometer, Watch & Clock-maker.
Hutton, Robert	11. Gloucester-street. Clerkenwell,	Examiner.
Hux & Sons	10, Spencer-street, Clerkenwell,	Watch-manufacturers.
Inglis, Frederick	New River Office, Green-terrace,	Secretary to the New River Company.
Isaac, H. P.	39, Essex-street, Islington,	Chronometer-maker.
Jaccard, D., & Son	26, Percival-street, Clerkenwell,	Watch-makers.
Jackson, H. J.	Berlin, Canada, West,	
Jackson, S.	66, Red Lion-street, Clerkenwell,	Watch-manufacturer.
Jeffery, W. R.	Saffron Walden, Essex,	Watch-maker.
Johansenn, A.	149, Minories, City,	Chronometer-maker.
Johnson, C. B.	Market-place, Prescot, Lancashire,	Manufacturer of Chronometer and Watch-hands and materials.
Johnson, E. D., F.R.A.S.	9, Wilmington-square, Clerkenwell,	Watch and Chronometer-manufacturer.
Johnson, S.	Harrow, Middlesex,	Watch-maker.
Jones, John, F.R.G.S.	338, Strand, London,	Watch and Chronometer-manufacturer.
Jurgensen, L. U.	Copenhagen, Denmark,	Chronometer-maker.
Kirk, J.	64, St. John's-street-rd., Clerkenwell,	Name Engraver.
Kinmuir, A.	38, Market-square, Lisburne, Ireland,	Watch-maker.
Klaftenberger, C. J.	157, Regent-street.	Watch and Chronometer-manufacturer.
Knight, Valentine, J.P.	Thorncroft, Leatherhead,	President of the Institute.
Knight, J. W.	1, Royal Exchange-buildings,	Stock and Share Broker.
Knudsen, F.	11, Moor-place, Kennington-road,	

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Name.	Residence.	Occupation.
Kullberg, Victor	12, Cloudesley-terrace, Liverpool-road,	Marine & Pocket Chronometer-manuf.
Lang, A.	Geneva, Switzerland,	Watch-manufacturer.
Lange, C.	9, Salisbury-street, Strand,	Watch-maker.
Langford, E.	Broad-quay, Bristol,	Watch-maker.
Laws, J. C.	54, Elmore-st., Essex-road, Islington,	Watch-finisher.
Lawson, J.	355, City-road,	Chronometer-maker.
Leeson & Son,	Coleshill, W., Birmingham,	Church, Turret, & House Clock Manuf.
Leonard, T.	50, Tabernacle-walk,	Turret Clock-maker, and Mechanician.
Lettsom, W. G.	H.M Charges des Affaires, Monte Video,	
Linde, Theo.	18, Fore-street, Devonport,	Watch-maker.
Little, James	5, Durham pl., Seven Sisters-rd, Holloway	Watch-maker.
Lowe, G. C.	Anne-street, Manchester,	Watch-maker.
Mc Clellan, J.	6, Broadway, Deptford,	Watch and Clock-maker.
Maclennan, J.	6, Park place, Highbury,	Chronometer-maker.
McDonnell, D.	65, Pentonville-road,	
McGregor, & Co.	30, Clyde-place, Glasgow,	Watch-maker.
McMaster & Sons,	Grafton-street, Dublin,	Watch-makers.
Madsen, H.	52, Frith-street, Soho,	Watch-maker.
Mariet, Sylvain	Locle, Switzerland,	Watch-maker.
Mander, C.	14, Queen-st, Percival-st., Clerkenwell,	Watch-gilder.
Manners, Admiral, F.R.A.S.	Henrietta-street, Cavendish-square,	
March, C.	Goswell-road, Clerkenwell,	Watch and Chronometer-maker.
Marriott, B.	38, High-street, Islington,	Watch-maker.
Maynard, W.	Exmouth, Devon,	Watch-maker.
Mercer, Thomas	45, Spencer-street, Clerkenwell,	Chronometer-maker.
Morgan, P. B. J.	31, Essex-street, Islington,	Finisher.
Morris, Wm.	Blackheath,	Watch and Chronometer-maker.
Morrison, J.	27, Packington-street, Islington,	Clock-manufacturer.
Morton, George	31, Hanover-street, Islington,	Chronometer-maker.
Muller, H.	Shanghai, China,	Chronometer and Watch-maker.
Muller, M. L.	40, Coleman-street, City,	Watch and Clock-maker.
Muncaster, G.	16, Duke-street, Douglas, Isle of Man,	Watch-maker.
Murray, J.	30, Cornhill, City,	Watch and Chronometer-manufacturer.
Mylne, G. F.	22, Great Percy-street, Clerkenwell,	Watch and Chronometer-manufacturer.
Mylne, H. J., Jun.	Ditto ditto	Junior Member.
Neville, W. G.	18, Lambeth-road South,	Watch-examiner.
Nickalls, T.	High-street, Reigate,	Watch and Clock-maker.
Nicole, A.	14, Soho-square,	Watch-manufacturer.
Norris, G. A.	32, High-street, Notting-hill,	Watch maker.
Noyer, P.	17, Noel-street, Islington,	Watch-manufacturer.
Oliver, J.	4, King-square, Clerkenwell,	Case-maker.
Oram, G. J.	19, Wilmington-square, Clerkenwell,	Watch-manufacturer.
Orkney, Earl of	Ennismore-place, Kensington,	
Orr, Peter	13, Loraine-road, Holloway,	Watch-maker.
Owen, W.	49, Craven-street, Coventry,	Watch-finisher.
Paillard, Vaucher, et fils	St. Croise, Switzerland.	Watch-manufacturer.
Palmer & Bachelders,	162, Washington-st, Boston, U.S.	Dealers in Watches, Jewellery, &c.
Palmer, Horatio	13, Charles-street, Northampton-square,	Watch-manufacturer and repairer.
Patek & Phillipe	68, Grand-quai, Geneva, Switzerland,	Manufacturer of Geneva Watches.
Penn,	52, Sloane-square,	Watch-maker.
Penlington, Joseph	Castle-street, Liverpool,	Watch-maker.
Pinkerton, Robert	8A, Upper Smith-st., Northampton-sq.,	Watch-maker.
Pitkethly, James	15, Clerkenwell Green,	Watch-maker.
Pitkin, G.	15, Upper Charles-st., Northampton-sq,	Chronometer and Watch-maker.
Pitkin, James	52, Red Lion-street, Clerkenwell,	Aneroid-maker.
Pool, J., Junr.	14, River-street, Myddleton-square,	Chronometer-maker.
Pratt, Henry	Ship-street, Brighton,	Watch-maker.
Preston, John	Eccleston, near Prescot,	Movement-maker.
Preston, Joseph	Eccleston-street, Prescot,	Chronometer & Watch Movement maker.
Prickett, George	5, Corporation-row, Clerkenwell,	Bovey & Prickett, Engine-turners, Engravers, & Dial-finishers.
Profaze, Joseph	25, New Bond-street,	Watch and Clock-maker.
Proudfoot, Thos,	8, Strachan terrace, Islington,	Watch Examiner.
Pyott, James	49, Spencer-street, Clerkenwell,	Compensation-balance-maker.
Redier, Mons.	16, Cour des petites Ecouriers, Faubourg St. Denis, Paris,	Clock-manufacturer.
Reefe, C.	75, Myddleton-street, Clerkenwell,	Watch Jeweller.
Rees, H. F.	1, Crow-lane, Coventry,	Watch Jeweller.
Reid, D. junr.	41, Grey-street, Newcastle,	Chronometer-maker.
Reid & Sons,	Ditto ditto,	Ditto
Reiss,	27, Watling-street, City,	Importer of Geneva Watches.
Richards, H.	14, Penton-street, Clerkenwell,	Watch-maker.
Richardson, Josiah	6, Russell-ter., Chapel-fields, Coventry,	Watch-manufacturer.
Riou, Riva	6, Rydon-street, New North-road,	Escapement-maker.

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Name.	Residence.	Occupation.
Roberts, J.	17, St. George-ter. Lonsdale-sq. Islington.	Watch-manufacturer.
Roberts, T. G.	3, Sudeley-st., Vincent-ter., Islington,	Watch & Chronometer Finisher.
Roberts, W.	35. Union-street, Stonehouse, Devon,	
Roe E.	Croft-cottages, Coventry,	Watch-manufacturer.
Rome, J.	6, King Edward-street, Islington,	Lever Escapement-maker.
Rotherham & Sons,	Coventry,	Watch-manufacturers.
Row, W. B.	Bournemouth,	Watch-maker and Jeweller.
Rowlands, Wm.	33, South-street, Clerkenwell,	Gold-case-maker.
Rowlands, C.	Ditto ditto,	Ditto ditto
Rowley, A.	65, Red Lion-street, Clerkenwell,	Brass-finisher.
Russell, Thos.	Hunter-square, Edinburgh,	Watch and Clock-maker, dealer in Watch tools and materials.
Sanders, J.	15, West-bar, Sheffield,	Watch-maker.
Sewill, J.	61. South Castle-street, Liverpool,	Chronometer & Watch-manufacturer.
Schoof, W. G.	9, Lower Ashby-st., Northampton-sq.,	Repairer and Examiner.
Shaw, W. U.	1, England-terrace, Regent-street, Hull,	Watch-maker.
Shepherd, J.	9, President-street East, Clerkenwell,	Watch-cap-maker.
Sheppard, Ed.	13, St James's-parade, Church-yard, Bristol,	Watch-manufacturer.
Schick, F.	58, Rahere-street, Islington,	Fuzee Chain-manufacturer.
Shorter, H.	11, Green-terrace, Islington,	Watch Escapement-maker.
Shufflebottom, C.	Chapel-fields, Coventry,	Escapement-maker.
Spiegalhalter, D.	129, Regent-street,	Watch-maker.
Spurrier, Henry	Tewkesbury,	
Stock,	19. Green-terrace, Islington,	Gold Case-maker.
Stoddart, Jas.	8, Hawley-road, Hornsey-road,	Watch-manufacturer.
Strachan, R.	11. Offord-road, Barnsbury,	
Straiton, A.	15, Little Knight Rider-st, Doctor's Com.	Watch & Clock-maker.
Storer, E.	46, Myddleton-square, Clerkenwell,	Escapement-maker.
Snowden & Sons,	27, Temple-street, Birmingham,	Watch-hand-makers & Material Dealers
Swindell, Jno.	17, Great Sutton-street, Clerkenwell,	Case polisher.
Taylor,	Pontefract, Yorkshire,	Watch maker.
Thickbroom, A.	6, Spencer-street, Clerkenwell,	Case-maker.
Tiede, J.	20, Jager-street, Berlin, Prussia,	Watch-maker.
Tilling, J. L.	1. Elizabeth-terrace, Liverpool-road,	Lever Escapement-maker.
Thompson, E. J.	5 & 6, Percival-street, Clerkenwell,	Watch-maker and Material Dealer.
Thonson, M.	4, Barnsbury-villas, Islington,	Watch-maker.
Thoms, W.	21, Percival-street, Clerkenwell,	Gilder.
Trevelyan, A. Esq., J.P.	Pencaitland, East Lothian,	
Trewinnard, J.	40, Providence-row, Park-road,	Watch Examiner.
Tribe, J. C.	6, Percival-street, Clerkenwell,	Clock-maker.
Turvey,	4, Amwell-street, Clerkenwell,	Tailor.
Twitching, W.	4, King's-square, Clerkenwell,	Watch Dial Enameller.
Vanscoliner, Rd.	294, Goswell-road, Clerkenwell,	Watch Jeweller.
Vincent, W. H.	89, Mount-street, Grosvenor-square,	
Vivier, O.	21, Sekforde-street, Clerkenwell,	Watch-manufacturer.
Wadham, G.	9, Milsom-street, Bath,	
Walker, C. V.	The Villa, Red-hill, Reigate,	Civil Engineer.
Walsh, A., M.I.C.E.	5, George-street, Euston-road,	Chronometer-maker.
Warman, F. R.	49, Spencer-street, Clerkenwell,	Watch Engraver.
Watson, J. F.	7, St John's-square, Clerkenwell,	Watch-manufacturer.
Webb, H. G.	159, St. John-street-road, Clerkenwell,	Gold Case-maker.
Webber, J. A.	101, Rothesay-terrace, Cardiff,	
Webster, H.	340, City-road,	Watch-manufacturer.
Webster, Rd.	74, Cornhill, City,	Chronometer, Watch and Clock-maker.
Wells, J.	42, Percival-street, Clerkenwell,	Case-maker.
Whipp, Jno.	51, Yorkshire-street, Rochdale,	Watch-maker and Jeweller.
White, C.	Albany-street, Regent's-park,	Watch-maker.
Willis, Thos.	15, Clerkenwell Green,	Jeweller & Watch-manufacturer.
Winter, James	224, King-street, Hammersmith,	Watch-maker.
Winter, R.	Chieveley, Berkshire,	
Wortley, W. N.	Finsbury Savings Bank, Sekforde-street	Actuary.
Wright, Stephen	Selby, Yorkshire,	Watch-maker.
Wrottesley, Lord, F.R.S.	Wrottesley-hall, Wolverhampton,	Astronomer, &c., &c., &c.
Wycherley, J.	New-road, Prescot, Lancashire,	Movement-maker.
Young, J. W.	5, Crawford-street, Portman-square,	Dealer in Watch Oils, &c.
Young, Robt.	35, Lindock-street, Greenock,	Optician.

*** The above list will enable Members to observe who among their Friends are **Members** and thus *to* direct their persuasion towards those who are not.

With the materials at hand the best classification practicable has been made, where errors may be discovered the Editor will readily correct them if obliged by Explanations.

1st August, 1865.—Ed.

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